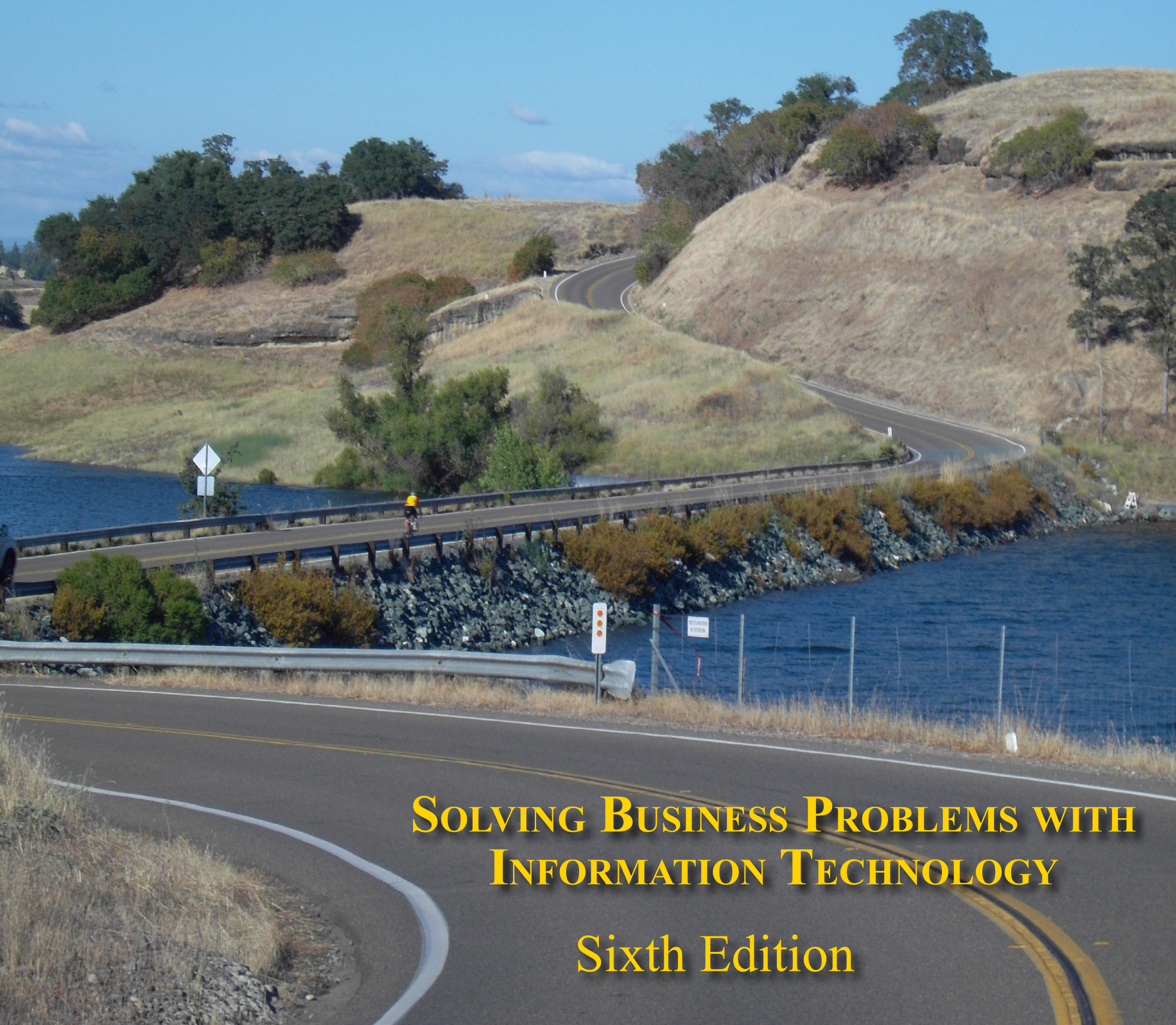
Gerald V. Post

Management Information Systems

Solving Business Problems with Information Technology

Sixth Edition



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Version 6.0.1

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University of the Pacific

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The cover photo shows a bicycle hill in Northern California but is a metaphor for the road to understanding information technology. It can be a fun road with scenery, climbs, and turns.

Students:
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To my parents.

Preface

Managers and Information Technology

Today, everyone uses computers. But does everyone use them efficiently? How many business people turn to a spreadsheet when a database would be a better tool? Do managers understand how information technology can solve business problems? As a future manager, do you know about all of the technologies that businesses are using? Can you spot a business problem and identify possible information technology solutions? Can you tell when a company is simply wasting money on technology and not solving problems?

Over the past decade, technology has changed many jobs. Competition and an economic downturn caused companies to cut costs wherever possible. In many cases, that meant reducing the number of employees. In the past few years, companies have used technology to alter and even eliminate management jobs. Twenty years ago, new college graduates could get entry-level jobs as managers, often performing relatively simple analytical tasks or summarizing data. Today, software does those jobs and generates detailed information on demand for executives.

If you want a job as a manager, you need to know how to use information technology. But it is not simply a matter of knowing how to use a word processor or spreadsheet. You need to use the technology to collaborate with other workers, to analyze data, and to find ways to improve your organization.

Continual changes in IT present two challenges: learning to use new technologies and finding new opportunities to improve management. Most students have taken a hands-on course that teaches them how to use a computer. Many expect the introductory MIS course to be more of the same—hands-on computer usage tied to specific needs. However, there are more complex and interesting problems to be solved. Managers need to apply their knowledge of IT tools to solve management problems and find new opportunities to improve their organizations. The focus of this book is to investigate the more complex question: How can information technology be used to improve management and make companies more efficient or better than their competitors?

Learning Assessment

After finishing the book, students should be able to evaluate common business problems and identify information technology solutions that could help an organization. Students should be able to explain their choices and point out potential problems or issues.

Anyone who teaches this material knows that this learning objective is difficult to meet—because of the huge number of possible issues and the flexibility required in analyzing problems. To meet the objective, smaller, and more concrete goals are presented in each chapter. Each of these is spelled out as a series of questions at the start of the chapter. By the end of each chapter, students should be able to provide intelligent answers to the various questions.

The book provides several tools to achieve its objectives. The industry cases and Reality Bytes show business problems and how organizations have attacked them. The body of the text explains the problems in more detail and focuses on the strengths and weaknesses of the various tools used to solve similar problems. The Technology Toolboxes and chapter exercises show students how to apply specific tools and concepts to solve problems.

Organization

The organization of the text builds from basic computer concepts to teamwork and strategy. Each section and chapter is focused on how managers can use information technology to solve business problems. In particular, the first section focuses on the information technology infrastructure—the specific tools and technologies used to collect, transfer, and store data. These hardware and software tools form the building blocks of any information system.

The second section explores how IT is used to support business integration and teamwork. It begins by analyzing the importance of computer security when sharing data, and includes chapters on enterprise resource planning (ERP) systems and using the Internet for electronic business. The teamwork chapter examines the role of recent tools for collaboration and teamwork—critical concepts in today's business organizations. These tools constitute some of the most recent additions to any company's toolbox. Any manager needs to be able to use these tools to work with colleagues across the room and around the world.

The third section focuses on tools to analyze data and make decisions. As the power of computers and software increases, more tasks get transferred to the machines. To adapt and grow, managers need to move to higher-level tasks including evaluating the data, identifying strategies, and organizing new businesses.

The fourth section looks at issues directly affecting the management of information technology resources. The chapters deal with how systems are developed and the management issues of the development process. Organizing the resources, particularly centralization and decentralization are also critical topics for managers who need to resolve conflicts and determine the best ways to fit IT into an organization. The last chapter looks at broader issues of how information technology decisions affect society and how the political and social environments influence business technology decisions. Privacy, crime, jobs, and education are topics that managers need to factor into their business decisions.

The organization of the text is based on two features. First, each chapter emphasizes the goal of the text: applying information technology to improve management and organizations. Second, the text is organized so that it begins with concepts familiar to the students and builds on them.

Each chapter is organized in a common format: (1) the introduction ties to the goal and raises questions specific to that chapter, (2) the main discussion emphasizes the application of technology and the strengths and weaknesses of various approaches, and (3) the application of technology in various real-world organizations is presented in the end-of-chapter cases.

Chapter 1 (Introduction) remains an introduction to MIS and provides an explanation of the goals—emphasizing the text's focus on how technology can help managers perform their jobs and improve the companies they manage.

Chapter 2 (Information Technology Foundations) reviews the basic issues in personal productivity and hardware and software. It emphasizes recent issues such as the growing importance of wireless devices. It also discusses issues in choosing computers used in e-business such as the importance of scalability in servers.

Chapter 3 (Networks and Telecommunications) explains the role of networks in managing businesses. It also explains the foundations of the Internet, so students can understand how problems can arise on the Internet and why certain technologies have evolved to solve them.

Chapter 4 (Database Management) explains the importance of database systems in business. The focus remains on managers' roles and uses of databases, such as querying databases and building reports.

Chapter 5 (Computer Security) focuses on the business problems and threats. It explains the various tools and the fact that business managers are critical in helping maintain computer security.

Chapter 6 (Transactions and Enterprise Resource Planning) raises the main issues in operations and transaction processing. It includes the role of accounting and HRM systems as well as supply chain management and customer relationship management, particularly payment mechanisms. The goal is to show managers how the systems are used to solve common business problems.

Chapter 7 (Electronic Business) describes the various ways that companies can use the Internet to extend their businesses. It includes traditional e-commerce applications, as well as Web services and mobile commerce.

Chapter 8 (Teamwork) explains the increasing importance of teamwork and collaboration tools. Managers need these tools in almost any business, and almost no other textbooks even

	Technology Toolbox
1	Choosing a Search Engine Finding Information on the Internet
2	Voice Input Creating Effective Charts
3	Creating Web Pages Transferring Files on the Internet
4	Building Forms in Access Creating Database Reports
5	Assigning Security Permissions Encryption
6	Selecting an ERP System Designing an EIS/Dashboard
7	Choosing Web Server Technologies Paying for Transactions
8	Collaborating with SharePoint Meeting Space and IM
9	Forecasting a Trend Browsing Data with a PivotTable
10	Locating Customers with a GIS Analyzing Businesses
11	Sending E-Mail Legally (CAN-SPAM) Creating a Business Plan
12	Creating Forms with InfoPath Programming a New Function in Excel
13	Defining E-Mail Rules Managing Projects
14	Privacy Working in a Global Environment

talk about them. Here, an entire chapter explains the problems that need to be solved and shows how the various tools support communication, collaboration, and knowledge management.

	Case focus: Industry
1	Fast Food
2	Computer Industry
3	Wholesale Suppliers
4	Pharmaceuticals
5	Professional Sports
6	Automobile Industry
7	Retail Sales
8	Package Delivery
9	Financial Services
10	Airline Industry
11	Entrepreneurship
12	Government Agencies
13	Energy Industry
14	Health Care

Chapter 9 (Business Decisions) begins with the basic importance of using analytical tools to make decisions. It then explains how basic tools help managers evaluate data, from decision support systems to data mining. Expert systems are introduced to show how computers can make more advanced decisions. Specialized tools and topics in artificial intelligence research are used to show how more intelligent software can solve even relatively complex problems.

Chapter 10 (Strategic Analysis) explores in detail how information systems are used to support the functional business areas to help gain a competitive advantage. The chapter also explores how IT helps entrepreneurs create new businesses.

Chapter 11 (Entrepreneurship) examines how information technology is used to start new companies and manage small businesses. By definition, small businesses have few employees so it becomes critical for entrepreneurs to leverage the technology to handle the thousands of details of managing a growing business.

Chapter 12 (Systems Development) looks at systems design and various development alternatives. It examines the challenges faced in developing software and the continuing movement to commercial off-the-shelf software.

Chapter 13 (Organizing MIS Resources) looks at the issues involved in the organization and management of MIS resources. In examining MIS roles, it also presents job opportunities. The chapter discusses how wireless, intranets, and Web services are having important effects on the structure and management of IT resources.

Chapter 14 (Information Management and Society) is an expanded discussion of the impact of IT on society—particularly the effects of the Internet. It investigates the issue of privacy versus business, social, and governmental needs. It examines the potential changes in a global society that is increasingly linked online.

Features That Focus on Solving Problems

Why do you need a textbook? You have access to the Internet and you can find millions of articles discussing technology, even online support for various software tools. You can read several online magazines about information technology—for free. Regardless of where you live, you can subscribe to manufacturer press releases and watch the technology change. You can subscribe to the Wall Street Journal and read about business, technology, governance, and host of other enlightening subjects. And yes, if you are serious about business and information technology, you should do all of these things. But you can still use a textbook. This textbook provides a structure to the information. It teaches you how the many pieces fit together to solve business problems. It provides the context and ideas on how to analyze the millions of tidbits of data floating on the Web. Use the textbook to provide the foundation knowledge that describes the information system discipline. Then when you read new facts and see new technologies evolve, you can understand how to use them to improve your career.

Each chapter contains several unique features to assist in understanding the material and in applying it to analyze and solve business problems. Each chapter focuses on a specific type of problem. These problems are highlighted by the introduction and demonstrated in the business cases. The text dissects the problems and explores how technology can be used to solve the problems.

- **What You Will Learn in This Chapter**. A series of questions highlight the important issues.
- **Lead Case**. An introductory, real-world case illustrates the problems explored in the chapter.
- **Trends**. Sidebar boxes present the major changes, brief history, or trends that affect the topics in the chapter.
- **Reality Bytes**. Brief applications, mini-cases, and discussions emphasize a specific point and highlight international issues, business trends, or ethics. They also illustrate problems and solutions in the real world.
- **Technology Toolboxes**. A short example and description of a software tool that can be used to help managers solve specific problems. They provide a hands-on example of specific projects. Students are encouraged to follow the exercises and use the software tools to build the examples.
- **Chapter summary**. A brief synopsis of the chapter highlights—useful when reviewing for exams.
- **A Manager's View**. A short summary of how the material in the chapter applies to building applications.
- **Key Words**. A list of words introduced in the chapter. A full glossary is provided at the end of the text.
- **Website References**. Web sites that provide discussions or links to useful topics.
- **Review Questions**. Designed as a study guide of the main topics in the chapter..
- **Exercises**. Problems that apply the knowledge learned in the chapter. Many utilize common application software to illustrate the topics. Questions and Exercises marked with a checkmark icon have at basic solutions available online. Students can check their knowledge and progress by checking their work on these exercises.
- **Additional Reading**. References for more detailed investigation of the topics.
- **Industry-Specific Cases**. In-depth discussion of the lead case and several other companies. Each chapter highlights a specific industry and compares

different approaches to the problems faced by the firms..

- **Rolling Thunder Bicycles Database Application**. A sample company database with integrated data for several years. Useful for demonstrating transactions, creating business queries, and analyzing data.

Goals and Philosophy

- All of the chapters emphasize the goal of understanding how information technology can be used to improve management. The focus is on understanding the benefits and costs of technology and its application.
- Emphasis is on the importance of database management systems. Increasingly, managers need to retrieve data, and utilize a DBMS to investigate, analyze and communicate.
- Emphasis is also placed on the importance of communication, teamwork, collaboration, and integration of data. Understanding information technology requires more than knowledge of basic application packages. Students need to use and understand the applications of groupware technologies.
- In-depth cases illustrate the use of technology. By focusing each chapter on a specific industry, students can understand and evaluate a variety of approaches. Many cases illustrate companies varying over time, so students can see the changes occurring in business and understand the evolving role and importance of information technology.
- The Rolling Thunder Database, a medium-size, detailed database application of a small business, is available on disk. Specific exercises are highlighted in each chapter. The database contains data and applications suitable for operating a small (fictional) firm. It also contains data generation routines so that instructors can create their own scenarios.

This Book Is Different from Other Texts

First, this book is a business text designed for an upper division or M.B.A. course, so it does not have the hundreds of step-by-step instructions to show students how to use a particular piece of software. It addresses the more difficult question of how to use information technology to solve business problems. Consequently, this text focuses on business issues first.

Second, this book is not simply a dictionary or encyclopedia that defines technology terms in one or two sentences. Students need to understand the various technology tools and see how they actually solve business problems. This book uses detailed cases to show the business problems and the technological solutions to illustrate each chapter. It also contains in-depth explanations of various technology issues, showing their strengths and weaknesses. Where possible, these tools are also demonstrated with hands-on applications, through the accompanying databases and through the Technology Toolboxes.

E-Book Edition

When Congress holds hearings about them you know that textbook prices have become absurd. Simply applying the concepts in this subject and textbook it is clear that e-books are the only viable answer. With this approach, prices are reasonable and students can download the book anywhere in the world, 24-hours a day. More important, students can keep the textbook for future reference. Yes, some people still like paper. If you truly believe you prefer paper, go ahead and print your own personal copy. But, before you kill a tree, check out the new tablet PCs and the Sony e-book Reader or Kindle DX using the e-Ink technology.

Changes to the Sixth Edition

Updates

The sixth edition keeps the same overall structure as the fifth edition. All chapters were revised and updated. The early chapters have more accurate and up-to-date descriptions, along with more figures describing the new technologies. All of the data charts have been updated to the most current data. All examples are illustrated with Office 2010 tools. There is a greater discussion of online tools. Almost all of the Reality Bytes are new, and all cases have been updated with a few new ones added. The data for Rolling Thunder has been improved and updated and extended through 2011 to provide more realistic analyses. About one-third to one-half of the exercises have been replaced or rewritten.

Newer topics have been added, including extensible business report language, computer forensics, virtual machines, near-field communications, telepresence, augmented reality, e-discovery, bandwidth hogs, and search engine optimization.

A new section on cloud computing was added to each chapter. Cloud computing has been around for a few years, but more options and tools are available and it is becoming popular, so managers need to understand the strengths and weaknesses of cloud computing. With the continued emphasis on mobile computing using smartphones and tablets, cloud computing becomes more important.

Focus on Business Problems

MIS is a business class, so students need to begin with the business perspective and then see how technology can solve the problems. The chapters emphasize this focus by beginning with a series of questions. Specific, real-world cases highlight aspects of these problems so that students see the problems in context. Almost all of the main cases have been replaced or updated. The chapter then addresses the questions and demonstrates how technology can be used to solve the problems. Each chapter begins with a set of questions that will be addressed—providing students with a direct learning objective. The questions also serve to increase student curiosity, by raising issues that they are not likely to have considered before. Several chapters have been restructured and the overall book has been reorganized to emphasize the business focus.

Technology Toolboxes

More details of technologies have been added. The goal is to build a stronger bridge between the underlying technologies and hands-on tools to business applications and strategies. Students should be encouraged to understand the technical as well as the business issues, and they should at least experiment with the technologies in the book. Chapters 2 and 3 include more technical details in particular.

Collaboration and Teamwork

Some of the biggest changes in software and technology in the last few years have been designed to improve collaboration and teamwork. It is critical that managers be able to use these tools, and they are not taught in typical introductory tools courses. This text covers these tools in Chapter 8 and uses Technology Toolboxes to demonstrate the basic features. In addition, each chapter contains teamwork exercises designed for collaboration by a group of students. Ideally, students would be able to use the collaboration tools while participating in these exercises.

New Cases and Reality Bytes

Most of the chapter cases and Reality Bytes examples have been replaced or rewritten. The book contains over 100 new Reality Bytes cases. All of the end-of-chapter industry cases have been updated and are tied to the specific problems in each chapter.

Instructional Support

Instructors have access to the following resources for course presentation and management. All the instructor supplements were created by the author, except the test bank:

- Instructor's Manual includes answers to all end-of-chapter review questions, exercises, and teaching notes for the industry-specific cases. Teaching tips and ties to the PowerPoint slides are included for each chapter.
- A test bank contains true/false, multiple choice, and short answer questions.
- Lecture notes are available as slide shows in Microsoft PowerPoint format. The slides contain all of the figures along with additional notes. The slides are organized into lectures and can be rearranged to suit individual preferences.
- Several databases and exercises are available online. The instructor can add new data, modify the exercises, or use them to expand on the discussion in the text.
- The Rolling Thunder database application is available in Microsoft Access format. It is a self-contained application that illustrates many of the concepts and enables students to examine any facet of operating a small company. The Instructor's Manual includes further guidance on how to incorporate this innovative tool into your course.
- The book's Web site at JerryPost.com provides resources for instructors and students using the text.

The Online System

To students, the most important change in the fifth and sixth edition is placing everything online. The main reason for this move is cost. The main textbook was rewritten and expanded. The costs and student prices for the print book was out of line. Electronically, it is possible to make the books available for an almost trivial fee.

E-books provide additional benefits, including advanced search capabilities. Students can also set bookmarks and highlight sections. More importantly, they get to keep the books, instead of being forced to sell them back at the end of the term. Database application development is an important topic, and the examples, comments, and tips in the books will be valuable to students throughout their careers.

Brief Contents

Contents

Chapter 1

Introduction

Chapter Outline

What You Will Learn in This Chapter

- How can MIS help you in your job?
- What is MIS?
- Why is information technology important? Why do all business majors need to study it?
- How important is the Internet in retail sales?
- Do you have too much technology?
- Do you know what a manager does?
- Do you know what a successful manager will do in the future?
- How is business changing? What will managers need to know in the future?
- Does technology alone improve a business?
- How do you break businesses into smaller pieces to analyze them?
- Why are strategic decisions so difficult?
- How do you begin searching for competitive advantage?

McDonald's

What do customers want? McDonald's Corporation has sold billions of hamburgers. Beginning in 1955 with a single drive-in in Des Plaines, Illinois, McDonald's has grown to today's system of more than 25,000 restaurants across 115 countries. As a brand, McDonald's is synonymous with a quality product at a reasonable price. Equally important, McDonald's markets itself as more than a place to get a hamburger. Ronald McDonald, Happy Meals, the clean restaurants, and each new product or promotional theme add to the fun that brings more than 40 million customers of all ages to its restaurants around the world each day.Eighty percent of worldwide McDonald's are franchiseyd. Each restaurant must meet strict requirements to make it the same as all others. This ensures that each time you drive or walk into a McDonald's, no matter where you are, the Big Mac that you order will always be the same taste, size, weight, and quality. It will also be competitively priced.

Eighty percent of worldwide McDonald's are franchised. Each restaurant must meet strict requirements to make it the same as all others. This ensures that each time you drive or walk into a McDonald's, no matter where you are, the Big Mac that you order will always be the same taste, size, weight, and quality. It will also be competitively priced.

Legal contracts, quality standards, and performance specifications direct the individual restaurants in the effort to keep all the food orders the same. What most individuals do not think about when they walk or drive into McDonald's is that McDonald's management information system (MIS) plays a critical role in ensuring the quality and consistency of each sandwich. McDonald's Corporation maintains a strict requirement that food be fresh and not stored more than a limited amount of time. MIS applications direct managers in the management of employees and the ordering and tracking of hamburgers, buns, potatoes, and soft drinks.

Competition is fierce in the fast food industry. The top chains have been struggling over the last several years to find a way to attract new customers. McDonald's experimented with changing menus. It altered its in-store system to focus on the "Made for You" campaign. Concerns about healthy food have led the company to try new foods and new ways of cooking. Following in the footsteps of Starbucks, McDonald's is offering wireless Internet access to customers for a fee. But is that what McDonald's customers really want? Will you go to McDonald's, pay money for a connection to the Internet, and then hang around to buy more food?

Introduction

How can MIS help you in your job? This is the ultimate question that you must continually ask and answer as you pursue a management career. This book explores many variations of this question and some useful answers. Information technology offers two main features to managers: (1) productivity and (2) innovation.

Productivity is the ability to accomplish more with fewer resources; and technology is often used to reduce costs. On a personal level, you are probably familiar with the basic personal tools such as a word processor, e-mail, spreadsheet, and Internet searches. All of these technologies improve your individual productivity.

Trends

Economies, businesses, people, and societies all change over time. A century ago, people were farmers and laborers. Most businesses were small. Technologies changed and people moved to cities and manufacturing jobs. Technology changed again, and the importance of the service sector grew. Although digital computers were invented in the early 1940s, it was not until the 1960s and 1970s that they became affordable for most businesses. At first, most companies used information technology to solve easy problems: transaction processing. Before computers, companies needed hundreds of bookkeepers in the back office tracking sales, updating ledgers, and summarizing data by hand. As hardware prices dropped in the 1980s and 1990s, businesses integrated personal computers into management. Networks—and today, the Internet—made it easier to share data and communicate. Information technology not only changes jobs, but also changes the way companies are organized. If you want a job in business, you need to know how to use these technologies to become a better manager and to improve the business. Remember that technology can perform amazing tasks. Businesses no longer need people to perform many of the menial middle-management tasks. Instead, businesses need managers who can think, adapt, and creatively find new solutions.

In the business world, these tools have largely eliminated the personal assistant, reducing costs and improving the response time. But, MIS goes way beyond these basic tools and the individual. As you will see, several technologies exist to help teams and the entire organization improve productivity.

Innovation is the creation of new things—new services and products, new markets, new business methods, and even new industries. Instead of cutting costs, information technology is used to open up new sources of revenue for businesses. Think about companies like Google (and the firms it bought), Amazon, and Match.com. These companies used information technology to create new ways to make money. Although less radical, many existing firms have found new ways to expand markets and make money with technology.

Innovation is sexier and more fun, but finding innovative ideas is considerably harder than using technology to increase productivity and reduce costs. These issues are part of the challenge of business strategy. Leaders and managers need to choose how their organization will view technology. Innovative uses require creativity and cost money, but can lead to gains against the competition.

As a manager, how can you use information technology to improve your business, increase sales, and gain an edge on your competitors? Keep in mind that technology changes rapidly. How do you know what tools to buy? Is it worth the money and risk to buy the latest technology? Can you rebuild your company to use the technologies? What do the customers want and how will they respond to technology? These are questions that managers face every day. The questions are challenging and the answers are hard to find. This book lays out a framework for analyzing your business problems and evaluating technology solutions.

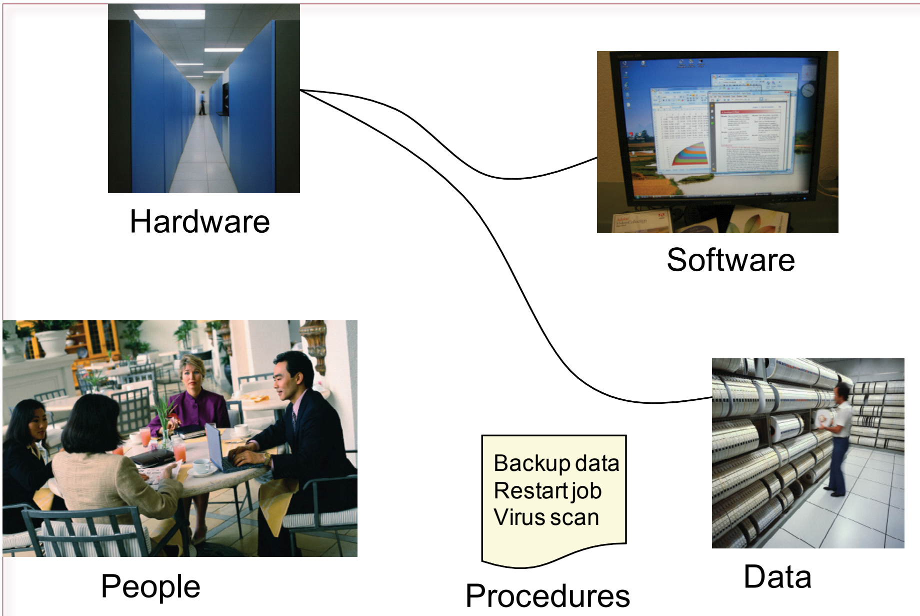


Figure 1.1

MIS Components. Information technology consists of the hardware and software, which includes networks. Information systems exist to process data. It takes people and procedures to create and run an information system. Information systems need to support users to help them make decisions.

The Scope of MIS

What is MIS? You probably have some experience with using computers and various software packages. Yet computers are only one component of a **management information system (MIS)**. As shown in Figure 1.1, an MIS consists of five related components: hardware, software (applications), people, procedures, and collections of data. More importantly, an MIS is designed to solve problems for the entire business. The term **information technology (IT)** represents the various types of hardware and software used in an information system, including computers and networking equipment.

The physical equipment used in computing is called **hardware**. The set of instructions that controls the hardware is known as **software**. In the early days of computers, the **people** directly involved in MIS tended to be programmers, design analysts, and a few external users. Today, almost everyone in the firm is involved with the information system, but some specialized MIS employees are needed to create and manage the information systems. **Procedures** are instructions that help people use the systems. They include items such as user manuals, documentation, and procedures to ensure that backups are made regularly. **Databases** are collections of related data that can be retrieved easily and processed by the computers. As you will see in the cases throughout the book, all of these components are vital to creating an effective information system.

So what is information? One way to answer that question is to examine the use of information technology on three levels: (1) data management, (2) information

Reality Bytes: Data, Information, Knowledge, and Wisdom

Consider the case of a retail store that is trying to increase sales. Some of the data available includes sales levels for the last 36 months, advertising expenses, and customer comments from surveys. By itself, this data may be interesting, but it must be organized and analyzed to be useful in making a decision. For example, a manager might use economic and marketing models to forecast patterns and determine relationships among various advertising expenses and sales. The resulting information (presented in equations, charts, and tables) would clarify relationships among the data and would be used to decide how to proceed.

It requires knowledge to determine how to analyze data and make decisions. Education and experience create knowledge in humans. A manager learns which data to collect, the proper models to apply, and ways to analyze results for making better decisions. In some cases, this knowledge can be transferred to specialized computer programs (expert systems).

systems, and (3) knowledge bases. **Data** consists of factual elements (or opinions or comments) that describe some object or event. Following the comments by Max Hopper (an early IT visionary at American Airlines) Data can be thought of as raw numbers, text, images, or even video. Data management systems focus on data collection and providing basic reports. **Information** represents data that has been processed, organized, and integrated to provide insight. Information systems are designed to help managers analyze data and make decisions. From a decision maker's standpoint, the challenge is that you might not know ahead of time which information you need, so it is hard to determine what data you need to collect. **Knowledge** represents a higher level of understanding, including rules, patterns, and decisions. Knowledge-based systems are built to automatically analyze data, identify patterns, and recommend decisions. Humans are also capable of **wisdom**, where they put knowledge, experience, and analytical skills to work to create new knowledge and adapt to changing situations. To date no computer system has attained the properties of wisdom.

Information systems continue to change over time. Computer hardware has advanced rapidly for several decades. As you will see in Chapter 2, these changes have enabled computers to handle increasingly complex data at faster speeds and lower prices. Similar improvements in data storage and transmission (networks) have opened up new options and methods of doing business. This increasing penetration of technology in business continues to cause changes in how companies operate. But, someone has to be in charge of the technology, evaluate the options, and keep everything running. The role of the people managing the information systems cannot be overemphasized. Many good careers exist in MIS and they are explored in Chapters 12 and 13. Most of them require business knowledge and skills—you do not need to be a "techie" or "geek"—and the pay has been relatively good, so as you read the chapters, try picturing yourself in one of these roles.

The Importance of Information Technology

Why is information technology important? Why do all business majors need to study it? Productivity is the bottom-line issue in informa-

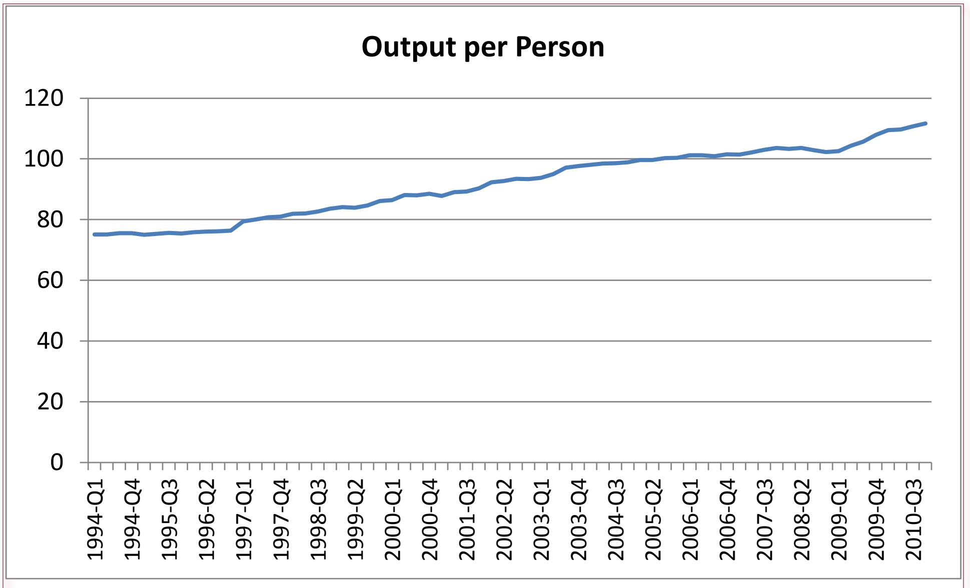


Figure 1.2

Productivity is an index of the amount of work per employee. There is a 33 percent increase in output over the decade from 1996-2006, with an average annual growth rate of 2.7 percent. Source: http://data.bls.gov/PDQ/servlet/SurveyOutputServlet?request_action=wh&graph_name=PR_lprbrief.

tion technology. Workers are expensive, difficult to manage, and hard to remove. Information technology continues to decline in price with increased power and capabilities. Programmers are more creative, and new tools are being developed to solve more complex problems. Organizations that use information technology to reduce costs and provide better service can thrive. If you want a job in management, you must learn to use the technologies. But it is not as simple as knowing how to use a spreadsheet and a word processor. You have to understand how businesses work and determine how technology can be used to improve the business.

Productivity

Figure 1.2 shows the productivity index for U.S. non-farm workers. In the seven years from 2000-2006, productivity grew at an average annual rate of 2.9 percent, but it was closer to 5 percent at the start of the century. Over about 15 years, productivity increased by about 47 percent. The other way to look at productivity is that each year, a firm needs fewer workers to produce the same level of service—which means it can operate at lower costs. Basically, the only way to achieve this continued growth in productivity is for workers to become more efficient—either through learning or improved use of technology.

As a manager, it is critical that you understand two implications of this trend. First, you have to use information technology to stay competitive. Today, computers are almost always cheaper than people. Second, at an average productivity rate of about 3 percent per year, productivity will increase by 34 percent in a decade. Firms would be able to produce the same output with 34 percent fewer workers. What happens to those workers? Chapter 14 addresses the economic issue in more

Reality Bytes: Jobs

CareerCast.com a career Web site annually rates jobs on the basis of several factors including income, stress, and job outlook. In 2011, based on a study of 200 jobs, the top career was: software engineer. Jesse Severe is a software engineer in San Diego working for ProFlight, LLC designing flight training software. He says "My job's flexible, pays well and gives [me] a lot of job satisfaction." Typical salaries for software engineers average about $87,000 up to $132,000. Many jobs exist for programmers across the U.S. and opportunities exist for entrepreneurs to develop their own software and companies. One of the challenges with programming is that technology, both hardware and software, continue to change. Consequently, the job requires constant education. Mr. Severe observes that "You can't think that you'll learn a skill and that it will be relevant in six months." Most people in the field look on technology change as a positive aspect. Tomorrow or next year there will be new tools and new challenges. The top five jobs on the list in 2011 were: (1) Software Engineer, (2) Mathematician, (3) Actuary, ($) Statistician, (5) Computer Systems Analyst. Note that all of them involve data and require analytical skills. The worst job on the list was roustabout--typically handling entry-level work on oil rigs and pipelines.

Adapted from Adapted from Joe Light," The Best and Worst Jobs," Th*e Wall Street Journal*, January 5, 2011.

detail, but you are going to be better off if you are one of the workers who understands and uses the technology to keep your job.

Teamwork and Communication

Teamwork is a key element in business. Teamwork means that tasks are divided among team members. You are responsible for completing specific items. You are also responsible for helping the other members of the team to find the best solution to the problems. Teamwork requires cooperation, but with technology, it no longer means that the teams have to work in the same room. Your team members may participate from around the world. Even if everyone is in the same room, you need technology to organize and share the contributions.

At a minimum, you already know how to use a word processor and a spreadsheet to write reports and analyze data. Do you know what changes have been made to these tools in the last few versions? The most important changes have been support for collaboration tools that make it easier to share documents and work as teams. Working on a team is difficult. Not only do you have to produce your own work, but you also have to communicate closely with the group to see what problems and answers they have encountered and determine how to integrate all of the pieces. Chapter 9 explores these problems and examines some of the tools available to help you.

Business Operations and Strategy

Information technology is increasingly critical to the daily operations of a business. Obviously, online businesses cannot live without technology, but neither can the local grocery store, bank, or many other businesses. Computers process sales, handle payments, and place new orders. They also analyze the sales data and help set prices and predict trends. Information technology is also used to create new

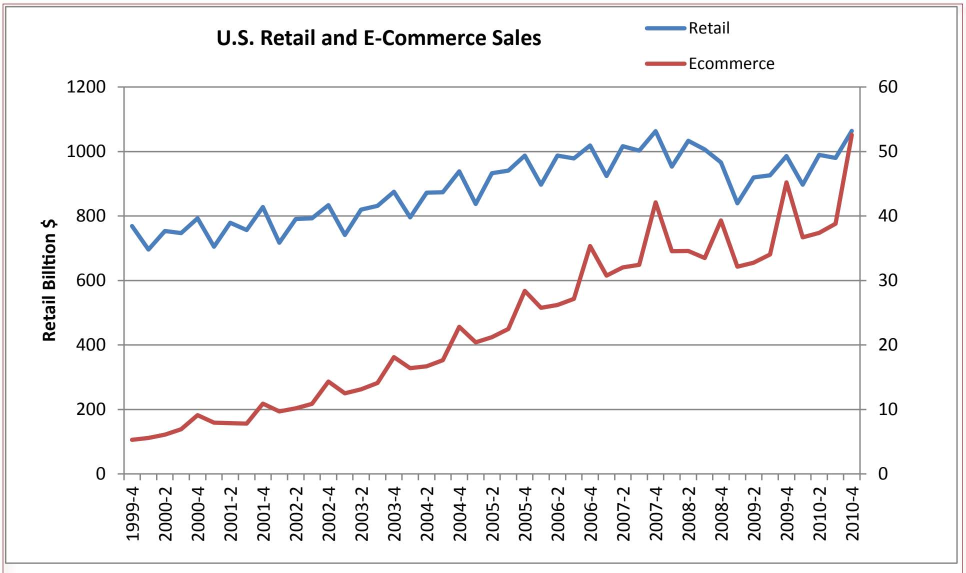


Figure 1.3

Retail and B2C e-commerce data in the United States. Although e-commerce sales are only 5 percent of the total, the percentage has been steadily increasing—despite the crash of the dot-coms in 2000 and 2001. Notice the seasonal peak in the fourth quarter—as more people go online to purchase holiday gifts. Source: http://www.census.gov/retail/index.html#ecommerce.

products and services or to provide unique features to existing products. These new features can give your company a strategic advantage and help the company grow.

The Role of the Internet in Business

How important is the Internet in retail sales? Today, almost everyone is aware of the Internet and many of its opportunities. But, how important is the Internet for sales? Electronic commerce, or **e-commerce** (EC), denotes the selling of products over the Internet. These sales can be from a business to consumers (**B2C**) or from one business to another (**B2B**). For a while in 1999, some people believed that e-commerce would become the dominant form of business—where everyone bought all items over the Internet. Thousands of firms and Web sites were created, trying to become the dominant firm in some niche. The group was called **dot-coms** because almost all had an Internet address of something.com. Many of the firms received huge amounts of funding from venture capitalists and experienced surprisingly high prices for their stock. Some foolish people predicted a new economic world. But beginning in mid-2000, thousands of these firms failed. Most had enormous expenses and huge losses. Many had been taking losses on every item they sold. And foolish people predicted the end of e-commerce. Figure 1.3 shows the U.S. statistics collected by the census bureau. The chart is somewhat misleading because EC sales are shown on the right-hand y-axis, versus total retail sales on the left. These scales make it possible to see the details in the EC data, but in reality, EC represents only about 5 percent of the

Reality Bytes: You are Already Too Old for This Job

Digital advertising is a new frontier, for consumers, companies, and advertising agencies. The big advertising agencies (Madison Avenue) have struggled to find experienced workers with knowledge of people who live and buy online. Jeff Tritt, an HRM executive at Leo Burnett, a large Chicago-based marketing firm, noted that "The demand is greater than the supply so there is a big war for digital talent right now." Some, such as WPP PLC's direct marketing unit Wunderman, are signing apprenticeship agreements with schools—getting students to work for pay or credit. Leo Burnett created a group of 35 young adults to function as a SWAT team to assist on accounts that need advice concerning the digital world. In a different twist, JWT, an ad firm of WPP created a reverse-mentor program where children ages 9 to 14 of JWT employees were brought in to work on client projects. In a project for Nestle, the kids' feedback led to the development of a mobile game to be used to promote items for the food giant. Beyond the children, the new workers not only need to understand the technology, they have to be able to use it. Wunderman brought in students to create a video to promote graphic design software from Microsoft. The students were able to complete the task in three days—instead of three weeks.

Adapted from Suzanne Vranica, "Kids Lend a Digital Hand," *The Wall Street Journal*, January 10, 2011.

total retail sales. The main point of the chart is that although small, EC sales are increasing at a faster rate than total sales. The second point to notice is the strong seasonal effect in the sales—particularly in EC. Year-end holiday sales provide a 35 percent boost to the EC numbers. This large number indicates that EC is still heavily used for gift and specialty items, instead of routine day-to-day purchases.

E-business is a more general term that encompasses e-commerce but also includes using the Internet for other business tasks, such as teamwork, communication, and new business services. As Internet technologies improve, more firms are offering e-business services—such as digital maps, remote data backup, and supply chain management. Chapter 8 discusses e-commerce and e-business in more detail.

Technology Excesses

Do you have too much technology? To some people (and organizations), technology becomes a goal by itself. They strive to be the leaders in acquiring technology and revel in the latest gadgets. The cell phone market is a leading example. Check out the offerings of the major carriers, the constant changes, and multitude of features. Now look around and notice that some people insist on having the most recent, fanciest, and often largest cell phones. Perhaps it is the bling factor, but do you really need to spend money to have the latest releases of technology? Bear in mind that most IT devices are most expensive when they are released, with prices often dropping rapidly over time. Figure 1.4 illustrates the common pattern in the release of new information technology. Prices decline over time and a new model is released with additional features. The rate of decline and the time frame (weeks, months, or years) depends on the specific technology. In all cases, you need to decide when you should purchase new technology. The answer should depend on a careful assessment of your needs, the features offered,

Figure 1.4

Information technology is often characterized by declining prices and new models. You can lead everyone and spend large amounts of money to buy new models whenever they are released, or you can keep technology until you truly need a new model.

and your budget. This analysis is the same for computers, enterprise software, and cell phones. But, with lower-priced items such as cell phones, the bling factor (and marketing) can override the judgment of consumers.

Consider a simple cell-phone example. New cell phones are constantly being introduced, and there might be a six-month (or year) lag in the release of new technologies. If you purchase a new phone every six months, you will spend at least $600 over the course of two years ($200 a phone but the first one is often free). If you keep the original phone and replace it every two years, you can generally get the phones free, or close to free. How many new features were introduced over two years? Is it worth $300 a year (or more) to have the most recent phone? Maybe it is—particularly when IT becomes a fashion accessory. But what about a $2,000 laptop for business? Should every person get a new laptop every year? The point is that these decisions depend on the individual. Until you need to evaluate the purchases for an entire organization. If you need to make the same decision for your company, you need to look at the true benefits to justify the additional costs. To make those decisions, you need to understand the technology and how it adds value to your firm. A key point in this book is that you need to begin thinking as a manager—responsible for analyzing decisions for the entire firm—not just yourself as an individual.

Another potential risk with information technology is that individuals might isolate themselves and rely on e-mail and text messages, avoiding interpersonal contact. Sometimes you need to meet face-to-face to get a true picture. Some

Reality Bytes: Hidden Data

Managers need information to make decisions—and sometimes they spend considerable time searching for information. A study of 1,000 middle managers at large companies by Accenture revealed that managers of American and English companies spent an average of two hours a day in their searches. But then, over half the data they find is worthless. Almost 60 percent said they had to use multiple sources to find data, and they typically needed three different sources. Almost half (42 percent) said they end up using the wrong data at least once a week. Much of the data, and the problems, are stored within the company. Most of the problems arise between managers. Almost half (40 percent) said that other managers are unwilling to share information. But, the respondents did help matters. Most of them said they store their most valuable information on their local computers and in their e-mail folders. It is hard to blame the problem on searching skills. The IT workers surveyed were the ones who most reported the data they found was worthless and they spent the most time looking for it. As much as 30 percent of their time was spent searching for data.

Adapted from Justin Lahart, "For Small Businesses, Big World Beckons," *The Wall Street Journal*, January 26, 2011.

communications are probably too important to use technology. Even in business, you need to be aware of the different preferences of people and know when to use technology and when to use a more personal approach.

So You Want to Be a Manager

Do you know what a manager does? Do you know what a successful manager will do in the future? Answer: The good ones work their tails off. But what exactly does a manager do? Managers actually have many tasks, and the roles depend on the culture of the organization, the style of top managers, and the skills of the individual manager. At one level managers are in charge of other employees, so they must organize tasks, set schedules, direct the processes, and communicate with other managers. On the other hand, managers often have to help with the ongoing operations. For example, an accounting manager also performs accounting tasks, and finance managers continue to analyze data. Finally, managers spend time communicating with others in the organization—both formally and informally. You always need to know what is happening in the company and how it will affect you.

Traditional Management and Observations

If you think of a traditional manager, you would consider tasks such as organizing work, planning jobs, and controlling workers. ("Joe, go peel those potatoes.") However, when observed at their jobs, managers appear to spend most of their time in meetings, talking on the phone, reading or preparing reports, discussing projects with their colleagues, explaining procedures, and participating in other activities that are difficult to fit into the traditional framework.

Henry Mintzberg, a psychologist who studies management, classifies managerial tasks into three categories: (1) interpersonal, (2) informational, and (3) decisional. Interpersonal roles refer to teaching and leading employees. Informational

Technology Toolbox: Choosing a Search Engine

Problem: How do you find information on the Internet? The Internet is huge and getting bigger. It contains an enormous number of pages. Content is provided by millions of organizations—each using different formats and terms.

Tools: Internet search engines were created specifically to crawl the Web and capture key words from the billions of pages they find.

Choosing the right starting point can be critical to a successful search. Obtaining the most number of hits is not as important as a site that returns accurate results. The main search companies constantly refine their methods to improve the accuracy. Remember the following hints when you are searching:

General purpose search engines
  Google, Bing, Yahoo
Meta-searches across multiple engines
  Dogpile, Yippy
Encyclopedia
  Wikipedia.org
Dictionary
  Wiktionary
Phone book
  Switchboard, Superpages
Products
  Mysimon, Cnet
Government data
  CIA.gov (World Factbook)
  Fedstats.gov (main data source)
  SEC.gov (EDGAR corporate filings)
Other
  Your library databases
  www.wolframalpha (math and data)

1. Google is currently the most popular search site and often returns the most hits. Bing and Yahoo are also good and sometimes the results are easier to read.
2. Some sites, such as Yippy, organize the results into categories.
3. Sometimes it is best to search an encyclopedia (wikipedia.org), dictionary (Wiktionary.com), a phone book (switchboard.com), the CIA World Factbook (www.cia.gov/cia/publications/factbook), or government statistics (fedstats.gov).
4. Check specialist magazine sites for targeted information. For example, use fortune.com to find information on the largest companies.
5. The most accurate sources are not free. University libraries provide access to huge commercial databases.

Quick Quiz: Where would you begin your search to answer the following questions?

1. Under the proposed IAU definition, which planetoid falls between Mars and Jupiter?
2. By revenue, which was the largest company in the world in 2010?
3. Find the best price on a 512 GB SSD.
4. Which U.S. professional basketball team had the fewest wins in the 2010-2011 season?
5. Which celebrities are still alive? Sophia Loren, Harman Killebrew, Phyllis Diller, Nancy Reagan, I.M. Pei.

Reality Bytes: Bicycles are Getting Expensive

Avid bicyclists have noticed huge increases in prices of high-end bicycles starting around 2005. Lightweight bicycles with carbon fiber or titanium frames could be purchased for $3,000-$5,000. By 2007, similar bikes from top-line manufacturers were commonly listed for $9,000-$10,000 or more. The pattern exists in road and mountain bikes. News in 2006 indicated that prices would continue increasing—this time because of shortages of raw materials. In particular, carbon fiber prices increased by 25 percent. Demand for the material along with titanium skyrocketed as airplane manufacturers increased production. Zsolt Rumy, CEO of carbon fiber manufacturer Zoltek Companies, Inc. in St. Louis said he was favoring his large customers (airplane manufacturers) to keep them happy. He passed on most of the 60-100 percent price increases to the sporting-goods customers, noting "we really jack up the price," for smaller customers. Titanium is relatively rare and in high demand, driving prices to more than $32,000 a ton—compared to $1,000 a ton for carbon steel. Still, 19.8 million bicycles were sold in North America in 2005—an 8.2 percent increase from 2004. Manufacturers estimate that 30,000 cyclists a year spend $3,000 or more on a bike.

Adapted from Paul Glader, "Why Bike Prices Are Shifting Higher," *The Wall Street Journal*, August 1, 2006.

tasks are based on the transfer of information throughout the organization, such as relaying information to subordinates or summarizing information for executives. Decisions involve collecting information, evaluating alternatives, and choosing directions that benefit the firm.

Other researchers have studied managers and developed alternative classifications. Fred Luthans uses three classifications of management activities. He indicates that approximately 50 percent of a manager's time is spent on traditional management activities (planning, organizing, and controlling), 30 percent in formal communications, and 20 percent in informal networking. Formal communications include attending meetings and creating reports and memos. Informal networking consists of contacts with colleagues and workers that tend to be social in nature but often involve discussions regarding business and jobs.

Making Decisions

In many ways managers expend a lot of their effort in making decisions or contributing information so others can make decisions. When you look at courses offered for future managers, you will find a focus on administration, human behavior, quantitative modeling and problem solving, decision theory, and elements of business ethics and globalization. Typically, these courses are designed to help managers solve problems and make decisions. However, if you ask managers how much time they spend making decisions, they are likely to say that they seldom make decisions. That seems like a contradiction. If managers and executives do not make decisions, who does?

In many organizations, day-to-day decisions are embodied in the methodology, rules, or philosophy of the company. Managers are encouraged to collect data and follow the decisions that have resulted from experience. The managers are

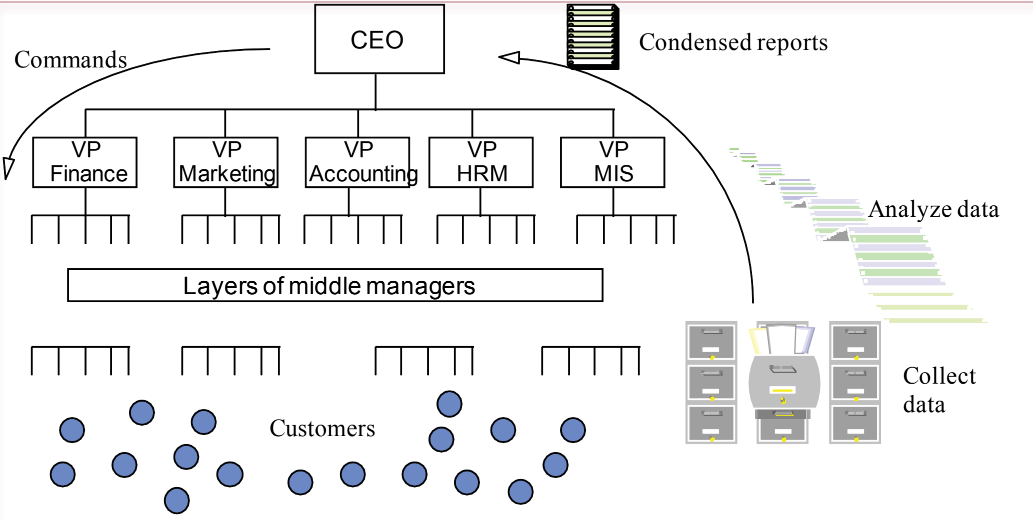


Figure 1.5

In a traditional organizational structure, lower-level managers deal with customers and collect basic data. Middle-level managers analyze the data, create reports, and make suggestions to upper-level managers. The higher-level managers make decisions and set rules to guide the other managers.

directly involved in the decision process, even though they may not think they are making the final choice.

The broader **decision process** involves collecting data, identifying problems, and making choices. Making a decision also requires persuading others to accept the decision and implement a solution. With this broader definition, many of the tasks performed by managers are actually steps in the decision process. Meetings, phone calls, and discussions with colleagues are used to collect data, identify problems, and persuade others to choose a course of action. Each of these steps may be so gradual that the participants do not think they are actually making decisions.

Because of the subtlety of the process and the complexity of the decisions, it is often difficult to determine what information will be needed. Decisions often require creativity. Because data generally need to be collected *before* problems arise, it is challenging to design information systems to support managers and benefit the organization. One important job of management is to examine the need for information and how it can be used to solve future problems.

Business and Technology Trends

How is business changing? What will managers need to know in the future? A key issue in management is that you must always work in the future. If you spend all of your time running around trying to solve today's problems by putting out fires, you will never succeed. You must plan for tomorrow and build the structure and processes to handle the day-to-day tasks.

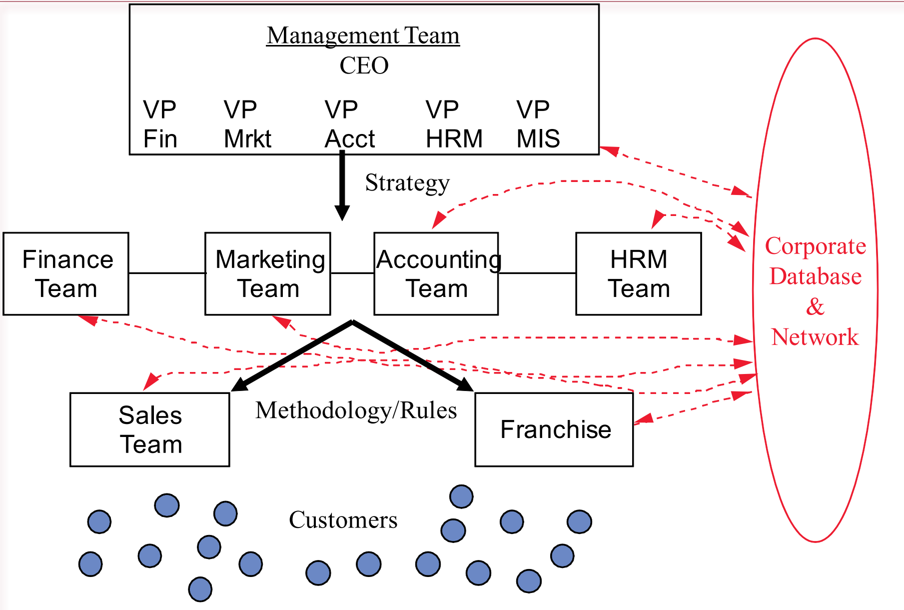


Figure 1.6

In the last few years, many companies have moved toward a more decentralized form of management. They have removed the middle layers of management and replaced them with smaller teams. Franchises and smaller teams have become the primary service contact with customers. Information sharing becomes crucial in this environment. Teams communicate directly and share data across the company.

Changes in Organizational Structure

Even without the Internet, management and companies are changing. The most important change is the move away from the traditional hierarchical structure to a team-based approach. Most of today's large companies developed years ago when communications were limited and there were no computers. Most adopted a military-inspired hierarchical command structure shown in Figure 1.5. The top-level managers set policy and directed the vice presidents to carry out the mission of the company. Sales staff dealt directly with customers, collected data, and passed it to middle managers. The middle managers organized and summarized the data and passed it up the chain. Little data was shared among the middle and lower levels.

In contrast, because it is easy to share data, information technology offers the ability to alter the way companies are organized and managed. Figure 1.6 shows the new approach. This method focuses on teamwork and a shared knowledge of all relevant data. Some teams, like sales and accounting, will have ongoing tasks. Other task forces will be formed to solve new problems—often created from managers across the company. Managers can expect to participate in many teams, essentially at the same time. Data can be obtained and shared through the information system, meetings can be held online, documents and comments can be circulated electronically.

This structure enables companies to be run with a smaller number of managers. Each manager is more productive because of the tools and the ability to perform many jobs. Another strength of this approach is that it is easy to use consultants

Business Trend	Implications for Technology
Specialization	• Increased demand for technical skills • Specialized MIS tools • Increased communication
Methodology and franchises	• Reduction of middle management • Increased data sharing • Increased analysis by top management • Computer support for rules • Reengineering
Mergers	• Four or five big firms dominate most industries • Need for communication • Strategic ties to customers and suppliers
Decentralization and small business	• Communication needs • Lower cost of management tasks • Low maintenance technology
Temporary workers	• Managing through rules • Finding and evaluating workers • Coordination and control • Personal advancement through technology • Security
Internationalization	• Communication • Product design • System development and programming • Sales and marketing
Service orientation	• Management jobs are information jobs • Customer service requires better information • Speed

Figure 1.7

Changes occurring in the business world affect the use of information technology. These trends and the implications are discussed throughout the book. Managers who understand these trends and their relationship with technology will make better decisions.

and temporary workers for short-term projects. In today's legal climate, it is exceedingly difficult to fire workers, so firms often use temporary workers for individual projects. Permanent workers, supplemented with specialized temporary talent, can organize a team. The team disbands when the project is finished.

Business Trends

As described in Figure 1.7, seven fundamental trends have been driving the economy and changing businesses: (1) specialization, (2) management by methodology, (3) mergers, (4) decentralization and small business, (5) reliance on temporary workers, (6) internationalization, and (7) the increasing importance of service-oriented businesses. These trends will be discussed throughout the text to illustrate how they affect the use of information systems and how managers can use information systems to take advantage of these trends. Tightening job markets also means that managers must continually work on self-improvement. To survive, you must provide value to the organization.

Reality Bytes: American Workers Must be Crazy

The Center for Work-Life Policy surveyed 1,600 workers who earned more than $75,000 a year. In 2007, almost half of those workers put in 60 hours a week and 10 percent were working more than 80 hours a week. Many of the workers (28 percent) in banking and finance had "extreme jobs" working more than 60 hours a week with unpredictable demands, travel, and tight deadlines. Most of the workers putting in over 60 hours a week said they loved their jobs. But half of those with "extreme" jobs said they wanted to quit within a year. Still, in a different online survey, 29 percent of 510 respondents said they would work more than 100 hours a week for their dream job. Remember that a week has only 168 hours. In other studies, American workers rarely use their full vacation allotment.

Adapted from Kyle Stock, "Would You Work 100 Hours a Week for Your Dream Job?" *The Wall Street Journal*, March 29, 2011.

Specialization

Adam Smith described the advantages of specialization and division of labor in manufacturing more than 230 years ago. The concepts are now being applied to managers. As functional areas (such as marketing or finance) become more complex, they also become more specialized. Area managers are expected to understand and use increasingly sophisticated models and tools to analyze events and make decisions. As a result, the demand for managers with specific technical skills is increasing, while the demand for general business managers is declining. First you get a job as an accountant (or whatever our specialty is), then you become a manager. This trend is reflected in MIS by the large number of specialized tools being created and the increased communication demands for sharing information among the specialists.

Management by Methodology and Franchises

Specialization's advantage is that it reduces management tasks to smaller problems. Using specialization coupled with technology, firms have reduced many management problems to a set of rules or standard operating procedures. Day-to-day problems can be addressed with a standard methodology. For example, the manager's guidebook at Wal-Mart or McDonald's explains how to solve or prevent many common problems. These rules were created by analyzing the business setting, building models of the business, and then creating rules by anticipating decisions and problems. This approach gives less flexibility to the lower-level managers but encourages a standardized product, consistent quality, and adherence to the corporate philosophy.

Management by methodology also allows firms to reduce their number of middle managers. By anticipating common problems and decisions, there is no need to call on trained managers to solve the daily problems. Franchises like McDonald's carry this technique one level further by making the franchisee responsible for the financial performance of individual units. The common management tasks, however, are defined by the central corporation.

Technology Toolbox: Finding Government Data

Problem: Many business problems require data, particularly regarding demographics and the economy.

Tools: The federal government collects a huge amount of data; much of it is now available online. The data is maintained by individual agencies and it helps if you know what types of data are provided by each agency. However, the main site www.fedstats.gov contains links to all of the agencies.

Agency	Main Types of Data	Site
Labor (BLS)	Employment and Prices	www.bls.gov/data
Census	Demographic and maps	www.census.gov
Economic Analysis (BEA)	Economic summaries	www.bea.gov
Transportation Statistics	Airline, rail, and road	www.bts.gov
Justice Statistics	Crime and courts	bjs.ojp.usdoj.gov
Economic Research (Ag)	Food and farm economics	www.ers.usda.gov
Health (CDC)	Health and Healthcare	www.cdc.gov.nchs
Securities and Exchange (SEC)	Business filings	www.sec.gov (EDGAR)

Most of the federal Web sites have the ability to download historical data, typically into spreadsheets. Some, as the BLS have search forms where you can select exactly which data you want to download. At all of the sites it is important that you read the descriptions carefully because there can be subtle but important differences in the series.

In the past couple of years, the government agencies have opened their databases to some of the search engines. In particular, Google and WolframAlpha can automatically search the databases and retrieve the data. In most cases, the data is returned as a chart, so if you truly want the underlying data, you might still have to go to the government Web site. But sometimes it is helpful to use the search engines to find the specific agency.

Quick Quiz:
1. What was the U.S. monthly unemployment rate for the last year?
2. What is the current population of the U.S.?
3. What was the value of the U.S. trade deficit for the last year?

Merger Mania

Up to the late 1800s and early 1900s, most businesses were small, having markets limited to small geographic regions. A brief history of industrial organization reveals four waves of mergers in the United States: (1) the horizontal mergers of the late 1800s epitomized by the oil and banking industries; (2) the vertical integration of the early half of the 20th century, illustrated by the oil, steel, and automobile companies; (3) conglomerate mergers of the 1950s and 1960s, in which firms like IT&T (an international telecommunications giant) acquired subsidiaries in many different industries (including a bakery!); and (4) giant horizontal mergers at the turn of the 21st century. All of these mergers arose to take advantage of economic power, but technology made them possible. Without communication (telegraph and telephones earlier, computer networks later), firms could not grow beyond a certain size because managers could not monitor and control lower-level workers.

The most recent mergers have been impressive in terms of the size of the firms and the sectors involved. The banking industry was one of the first to begin consolidation. Relaxation of federal restrictions quickly led to large regional and national banks. The telecommunications industry also experienced several changes, such as the ABC-Disney and AOL-Time/Warner merger between telecommunications and entertainment industries. Telephone, Internet, and cable companies also were fertile ground for mergers, such as MCI and WorldCom or AT&T, TCI, and the reconsolidation of the telephone companies. The horizontal mergers in the petroleum, food production, automobile, and grocery industries represented major consolidations of operations as well. Some of these combinations crossed international boundaries (e.g., Daimler and Chrysler or Chrysler and Fiat). Some of these trends were fueled by the high stock market valuations, which provided capital to the successful firms and punished the weaker ones.

One of the important keys to these mergers was the improved capability of information and communication technology. Without the IT structure, it would be exceedingly difficult to manage these combined firms. Most of the combinations also resulted in a loss of middle-management jobs. The remaining workers relied on technology to improve their productivity. The newly centralized firms also relied on communication technology to provide customer service across the country and around the world.

Decentralization and Small Business

Strangely, businesses today are becoming both larger and more decentralized. The goal of decentralization is to push the decision-making authority down to the level that deals with the customer. The top managers set strategy and establish projects across the organization. The lower-level managers and salespeople solve problems and make decisions to improve sales and negotiate with customers. The gap between these groups is bridged by information technology. Companies no longer need hundreds of middle-level managers to organize data and interpret top management commands. In the past, with limited information technology, small divisions were expensive to maintain because of the cost of collecting and processing the basic accounting and operating data.

Within a firm, operations can be decentralized into teams of workers. In this situation, departments operate relatively independently, "selling" services to other departments by competing with other teams. They often perform work for outside firms as well—essentially operating as an independent business unit within the corporation. The main goal of decentralization is to push the decisions and the

Reality Bytes: Visual Search

http://www.bing.com/visualsearch
http://image-swirl.googlelabs.com/
http://www.google.com/mobile/goggles/#text
http://images.google.com (Use Google Chrome)

Humans do not often remember items by name. People often visualize items and remember things by association. So it would be useful to have search engines that can find things based on images. The challenge is that computers are relatively weak at image recognition. The code is getting better, but search results based on actual photos are still relatively generic. Microsoft and Google both have tools to search for collections of images based on word tags. The Microsoft Bing engine has some useful collections, such as dog and cat breeds. Google tends to rely on images that are tagged by other users. Google Goggles is an early version of a search engine that uses an uploaded photo or a photo taken with a Smartphone to search for information related to the object.

Adapted from Katherine Boehret, "In Search Of...Images Worth 1,000 Results," *The Wall Street Journal*, January 12, 2010.

work down to the level of the customer, to provide better customer service and faster decisions. Information systems enable executives to gather and manipulate information themselves or with automated systems. As a result, there is less need for middle managers to prepare and analyze data.

At the same time that large business have consolidated and shed managers, many of these people have started their own small companies. Sometimes workers have become consultants—performing tasks similar to the jobs they left, but working part time for a variety of firms.

Temporary Workers

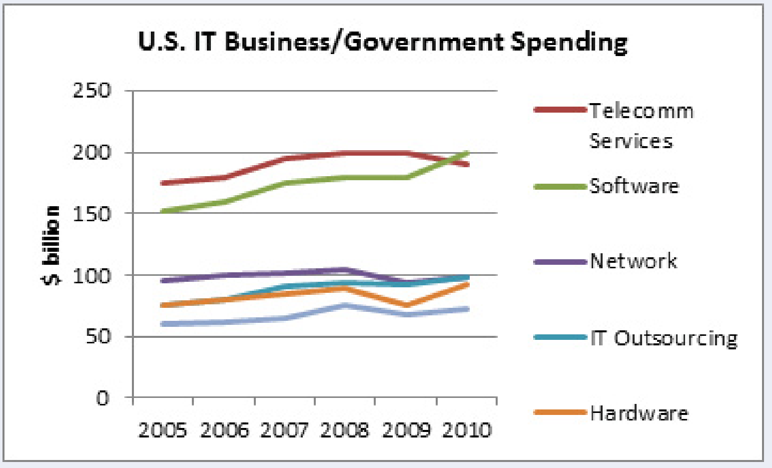
So what happens to the people who are no longer needed as middle-level managers? At various times in the past, some companies provided a form of lifetime employment for their workers. As long as workers continued to do their job and remained loyal to the company, their jobs were secure. Even in more difficult times, when employees were laid off, they were often encouraged (through extensions of unemployment benefits) to wait until the economy improved and they could be rehired. Companies in other nations, especially Japan, had stronger commitments to workers and kept them on the payroll even in difficult times.

Today, in almost every industry and in many nations (including Japan), all jobs are at risk. To compensate, companies increasingly rely on a temporary workforce. Individuals are hired for specific skills and tasks. When these basic tasks are completed, the employees move on to other jobs. Increasingly, even executives are hired because of their specific expertise. Consultants and other professionals are hired on a contract basis to solve specific problems or complete special assignments.

In many ways, it is more difficult to manage a company that relies on temporary workers. Special efforts must be made to control quality, keep employees working together, and ensure that contract provisions are met. Technology can play an

Reality Bytes: IT Spending

Forrester Research is a consulting firm that tracks trends and details in information technology. The company regularly reports on IT spending. Note that software and telecommunication services (phones and Internet) are the largest component of costs. Although, combining hardware and network equipment into a single category makes it about equal to the software costs.



Adapted from *The Wall Street Journal*, "Where the Money Goes," April 25, 2011

important role in these situations. It can improve communications, maintain easy (but controlled) access to data and contracts, and help to institute corporate standards. The Internet is beginning to play this management role—finding contract workers, negotiating the work, and distributing the finished products.

To you as a worker, the loss of middle-management jobs and reliance on temporary workers should be scary. It means more competition for jobs—particularly higher-level careers. To obtain higher-level jobs, you will need to possess more analytic skills than other potential employees. Even as a manager, you will need your own competitive (professional) advantage. Along with additional education, your use and knowledge of technology can give you an advantage.

The issue of contract workers is particularly critical with computer programmers and developers. Many firms want to hire contract programmers because they will no longer be needed after an initial application is developed. This approach works until the economy booms, then it becomes exceedingly difficult to find workers. In the end some companies find they have to hire permanent workers simply to avoid the problems of trying to find new contractors every couple of years.

Internationalization

Several events of the early 1990s demonstrated the importance of international trade: closer ties forged with the European Union, creation of the North American Free Trade Area (NAFTA), and the continued relaxation of trade restrictions through the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO). Although barriers to trade remain, there is no doubt that the

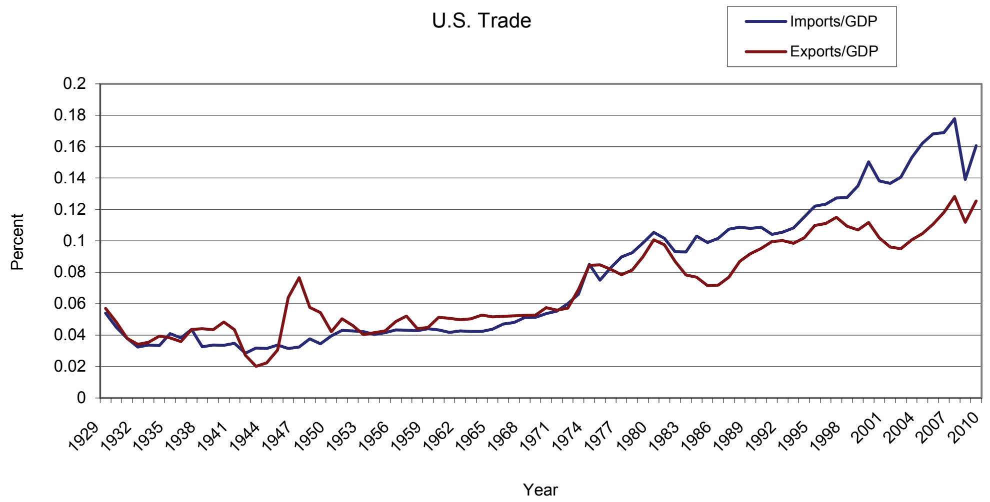


Figure 1.8

By almost any statistic, in almost every nation, the level of international trade has increased dramatically during the last 20 years. International trade brings more choices, more competition, more data, more complexity, and more management challenges. Source: http://www.bea.gov/national/nipaweb/Index.asp.

international flow of trade and services plays an increasingly important role in many companies. Even small firms are buying supplies from overseas and selling products in foreign markets. Trade also brings more competition, which encourages firms to be more careful in making decisions.

As Figure 1.8 shows, the role of exports and imports has expanded rapidly in the United States since 1970. In European nations, international trade is even more important. Today, internationalization is a daily fact of life for workers and managers in almost every company. Even small businesses have links to firms in other nations. Many have set up their own production facilities in other nations. Much of this global expansion is supported by technology, from communication to transportation, from management to quality control.

Communication facilities are one of the most prominent uses of information technology to support the move to international operations. Communication technology is especially important for service industries such as consulting, programming, design, marketing, and banking. Several years ago, services were often considered to be nontradable goods because they tended to have high transportation costs, making them difficult to export. Today, improved communication facilities through the Internet have made certain types of services easy to export. For example, financial institutions now operate globally. Today, software development has a growing international presence. Many U.S. firms are turning to programmers in Ireland, India, and Taiwan. Through the use of programmers in India, for example, a U.S.-based firm can develop specifications during the day and transmit them to India. Because of the time difference, the Indian programmers work during the U.S. night and the U.S. workers receive updates and fixes the next morning.

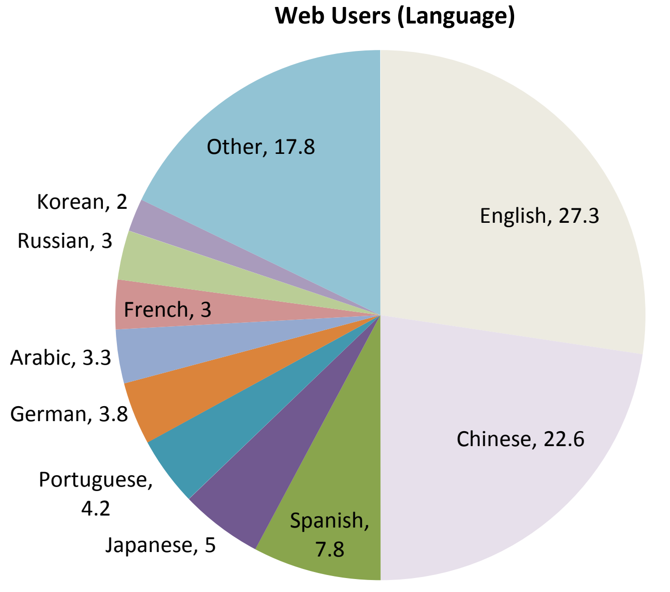


Figure 1.9

Internationalization of the Web. Percent of user languages estimated from Web browser settings. Source: http://www.internetworldstats.com/stats7.htm (2010).

Internationalization also plays a role in selling products. Groups of countries have different standards, regulations, and consumer preferences. Products and sales techniques that work well in one nation may not transfer to another culture. Information technology can track these differences, enabling more flexible manufacturing systems that can customize products for each market.

Figure 1.9 shows one way to look at internationalization on the Web. It shows the percentage of Web browsers configured for the top ten languages in 2010. English is still at the top of the list, but it is followed closely by Chinese. These numbers are relatively accurate because servers can be configured to recognize the language of the client browser and the statistics are collected automatically.

Figure 1.10 shows a broader picture by counting the number of Internet users in each geographical region. These numbers are somewhat more subjective because someone (typically the Nielsen agency) has to estimate the number of people in each nation and region who use the Internet on a regular basis. This survey approach can miscount people—particularly those who get access through work or school. Still, it shows the international character of the Internet. It does not take a high percentage of users for regions with large populations to dominate. Asia's 825 million users is only about 30 percent of the people versus about 75 percent for North America Do the statistics mean that you can create a Web site and begin selling items to the hundreds of millions of Chinese and Indian Web users? Based

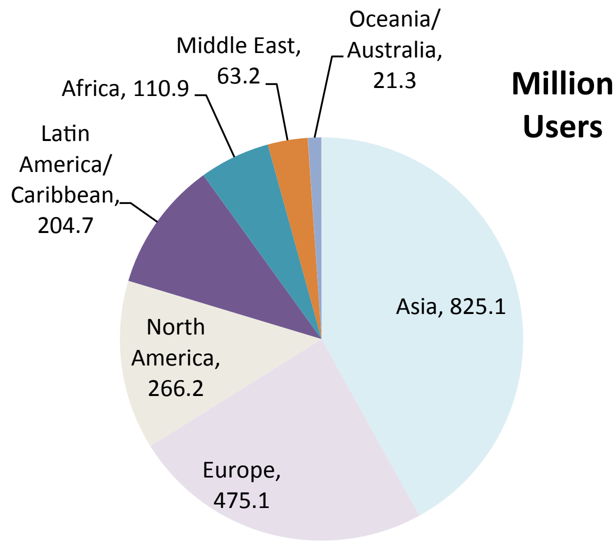


Figure 1.10

Internationalization of the Web. Number of users by geographic region. Source: http://www.internetworldstats.com/stats.htm (2010).

on the fact that businesses have been attempting to expand into Asia for decades since Nixon's trade mission in 1973, it will probably take a while. Keep in mind that per capita income is still lower in those nations, and much of the infrastructure developed for the Western world is not yet in place in Asia—including shipping and payment methods.

The increased competition created by internationalization and decentralization requires corporations to be more flexible. Flexibility is needed to adapt products to different markets, choose suppliers, adopt new production processes, find innovative financing, change marketing campaigns, and modify accounting systems. Firms that attain this flexibility can respond faster to market changes, catch opportunities unavailable to slower firms, and become more profitable.

Service-Oriented Business

Another trend facing industrialized nations is the move toward a service-oriented economy. As shown in Figure 1.11, in 1920 the U.S. census showed 29 percent of the employed were in farming. By 2000, that figure had fallen below 1 percent. In the early 1900s, people were afraid that this trend would cause food shortages throughout the United States and the world. Improvements in technology in the form of mechanization, transportation, growing techniques, chemicals, and crop genetics proved them wrong.

A similar trend in manufacturing has produced the same consternation. Although the number of workers employed in manufacturing has varied over time, it is clear that the largest increase in jobs has been in the management, clerical, and service sectors. In 2010, 11 percent of the jobs were in manufacturing, with

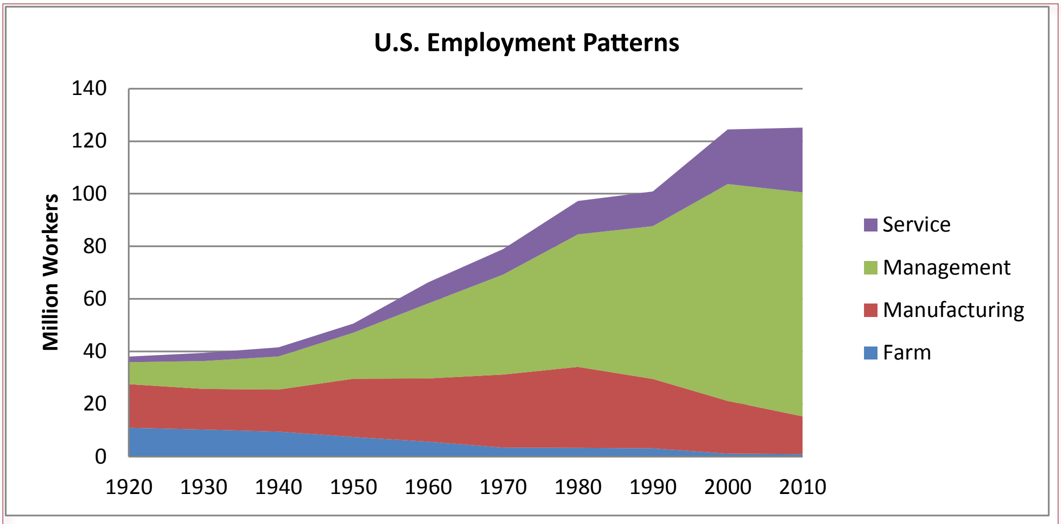


Figure 1.11

Over time, Americans have moved from agricultural to manufacturing to service and management jobs. Management and service jobs are often dedicated to collecting and analyzing data. Just as the decline of workers in agriculture did not create a shortage of food, the relative decline in manufacturing did not create a shortage of products.

88 percent in service and management jobs. The largest increase in new jobs has been in the management, clerical, and service sectors.

These trends represent changes in the U.S. economy and in demographics such as age characteristics of the population. The importance of the management, clerical, and service sectors has to be considered when examining how MIS can benefit a firm and its workers. The goal is to gain a competitive advantage through better customer service. Even manufacturing companies are beginning to focus their efforts around the concept of providing services to the customer.

Reengineering: Altering the Rules

Does technology alone improve a business? Many companies are managed by rules and procedures. It would be virtually impossible to do otherwise—the cost of an intense evaluation of every single decision would be overwhelming. Hence, upper-level managers establish procedures and rules and an organizational structure that automatically solve typical problems. More complex problems are supposed to be identified by managers and forwarded up the chain of command for answers.

This type of management creates a fixed approach to operations and to solving problems. However, the business environment rarely remains constant. Over time, new technologies are introduced, new competitors arrive, products change, old markets shrink, and firms merge. At some point, firms that have been guided by relatively static methodologies find their methods no longer match the marketplace. Hence, they decide to **reengineer** the company: beginning from scratch, they identify goals along with the most efficient means of attaining those goals, and create new processes that change the company to meet the new goals. The

Reality Bytes: Driptech with 20 Employees Goes International

Peter Frykman is the owner of Driptech, a small irrigation equipment company headquartered in Palo Alto, California. The firm has 20 employees—but seven of them are located in China and India. Mr. Frykman was part of a group of Stanford University graduate students who designed a method to make drip irrigation systems inexpensively. The group tested the equipment in Ethiopia, formed the startup company, and raised $900,000 in funding. After a pilot project in India kicked off sales in Asia in 2009, Chinese officials became interested in the technology. Driptech set up offices in Mumbai and Beijing, and Mr. Frykman soon expects half his employees to be overseas. He notes that having offices in three countries is difficult, but with modern communication technology he is able to pass work around the world and have engineers working continuously. He notes that “If you get the rhythm right, you can really be working around the clock as an organization.” A few other companies also work internationally, but the U.S. Census Bureau notes that only two percent of small companies (fewer than 100 employees) sell their products in overseas markets.

Adapted from Justin Lahart, “For Small Businesses, Big World Beckons,” *The Wall Street Journal*, January 26, 2011.

term *reengineering* and its current usage were made popular in 1990 by management consultants James Champy and Michael Hammer. Many of the underlying concepts have been in use for years.

Sometimes reengineering is undertaken by internal management as a means to improve the company. For example, in the early 1990s, Compaq Computer altered its strategy and reengineered its operations and management to cut millions of dollars in costs and save the company. But in 2000, Dell Computer’s just-in-time and made-to-order production system dominated the industry. Unable to alter the company fast enough, Compaq was ultimately purchased by Hewlett-Packard.

Sometimes reengineering is forced on the company when it is taken over by another corporation. In a few rare cases, managers continually evaluate the firm to make several small changes instead of relying on a major overhaul.

Reengineering can be a highly complex process, requiring thousands of hours of time to analyze the company and its processes. In addition to the complexity, reengineering often faces resistance because it results in a change in the organization’s structure, which affects the authority and power of various managers.

Like any management technique, reengineering is not guaranteed to work. A report by CSC Index, a major reengineering consulting company, that surveyed 497 large companies in the United States and 124 in Europe, noted that 69 percent of the American and 75 percent of the European companies have already undertaken reengineering projects. Several of these projects have not been successful. CSC Index notes that three factors are necessary for success: (1) overcome resistance by managers who are afraid of losing jobs or power, (2) earn strong support by upper management, and (3) aim high and go for major changes instead of small rearrangements.

Often, the point of reengineering is to rebuild the company so that it can make better use of technology. Simply placing computers into a firm, or just buying replacement computers, does not provide many advantages. The key to technology is to restructure the operations and management to reduce costs and make better

Figure 1.12

There are three primary levels of decisions in business. Business operations consist of tasks to keep the business operating on a day-to-day basis. Tactical decisions involve changes to the firm without altering the overall structure. Strategic decisions can alter the entire firm or even the industry. Information system tools exist to help with each type of decision.

decisions. For example, in the 1980s, replacing a secretary's typewriter with a personal computer had some benefits. But firms ultimately gained more benefits by giving personal computers to managers and eliminating the secretary. Today, you might consider simply updating those personal computers. However, building an information system that provides easy-to-read up-to-the-minute data to top management makes it possible to eliminate the lower-level managers and still make better decisions.

One of the challenges of reengineering is that the proposals can seem drastic. What do you mean you want to eliminate half of the corporate-level employees!? But being driven out of business by a leaner, lower-cost competitor is always a worse situation.

Management and Decision Levels

How do you break businesses into smaller pieces to analyze them? To understand management, reengineering, and information systems, it helps to divide the organization into three decision levels: strategy, tactics, and operations. Each level has unique characteristics, which use different types of support from information technology. These levels were explained by Robert Anthony in 1965. In 1971, Gorry and Scott Morton added a detailed explanation of how information systems at that time could support the various levels of management. However, the terms and characteristics are largely taken from military terms. Throughout history, in most nations the military has been the largest organization in terms of the number of "employees." Figure 1.12 is an updated picture of the typical pyramid shape of most organizations involving operations and tactical and strategic decisions. As is typical with most management models there are many gray areas and the lines are not absolute.

Reality Bytes: Fewer Workers More Output

Looking at the statistics, it is clear that employment at manufacturing companies in the U.S. has been declining for 40 years. But due to increases in productivity, total manufacturing output over that time has increased. U.S. companies are producing more than twice the output they did 40 years ago. In the meantime, even in low-wage countries such as China, a shortage of workers is driving wage increases of 15 percent or more. Christian Murck, president of the American Chamber of Commerce in Beijing notes that “China’s low-wage advantage will disappear over the next five years. Supply chains are already being disrupted.”

Adapted from John Bussey, “Analysis: Will Costs Drive Firms Home?” *The Wall Street Journal*, May 5, 2011.2004.

The power of the model is that it makes it easier to solve business problems. With any problem, your goal is to identify the primary management level. Once you know the level, it is easier to focus on the types of solutions that will be relevant. For example, if a company is having basic problems with its day-to-day accounting, you would focus on improving the data collection—and worry later about strategic tools and problems with competition. As you read the cases and Reality Bytes throughout this book, you should identify the primary level of each problem.

Operations

The *operations level* consists of day-to-day operations and decisions. In your first job, you will typically concentrate on the problems that arise at this level. For example, in a manufacturing firm, machine settings, worker schedules, and maintenance requirements would represent management tasks and decisions at the operational level. Information technology at this level is used to collect data and perform well-defined computations. Most of the tasks and decisions are well **structured**, in the sense that they can be defined by a set of rules or procedures. For example, a clerk at Wal-Mart follows the procedures in the guidebook to deal with

Figure 1.13

Each functional area of management faces the three categories of decisions and problems. Only a few examples are presented here.

Sector	Operations	Tactics	Strategy
Production	• Machine settings • Worker schedules • Maintenance schedule	• Rearrange work area • Schedule new products • Change inventory mode	• New factory • New products • New industry
Accounting	• Categorize assets • Assign expenses • Produce reports	• Inventory valuation • Depreciation method • Finance short/long term	• New GL system • Debt vs. equity • International taxes
Marketing	• Reward salespeople • Survey customers • Monitor promotions	• Determine pricing • Promotional campaigns • Select marketing media	• Monitor competitors • New products • New markets

Level	Description	Example	Type of Information
Strategy	Competitive advantage, become a market leader. Long-term outlook.	New product that will change the industry.	External events, rivals, sales, costs quality, trends.
Tactics	Improving operations without restructuring the company.	New tools to cut costs or improve efficiency.	Expenses, schedules, sales, models, forecasts.
Operations	Day-to-day actions to keep the company functioning.	Scheduling employees, ordering supplies.	Transactions, accounting, human resource management, inventory.

Figure 1.14

Each decision level affects the firm in different ways. Each level uses and produces different types of information.

typical operations. Common problems are anticipated, with actions spelled out in the guidebook. Computer security is an increasingly important problem—for both individuals and companies. Chapter 5 examines the major threats and tools available to protect your assets.

As summarized in Figure 1.13, managers in other disciplines—such as accounting, marketing, or finance—also face operational decisions. Personal productivity tools, like spreadsheets, word processors, and database management systems help managers collect and evaluate data they receive on a daily basis. The use of these tools is reviewed in Chapter 2.

An important task at the operations level is to collect data on transactions and operations; hence **transaction processing systems** are a crucial component of the organization's information system. The data collected form the foundation for all other information system capabilities. As discussed in Chapter 6, an important characteristic of transaction processing systems is the ability to provide data for multiple users at the same time. A special class of transaction processing software designed for factory operations is called *process control* software. Chapter 7 shows how modern **enterprise resource planning (ERP)** software extends the concepts of transactions across the organization.

Database management systems are increasingly used to control data and build systems to share data. Their role is explained in Chapter 4. Chapter 3 shows how communication networks are used to provide access to data throughout the organization. Increasingly managers work in teams—either with workers in the same department or across departments and sometimes companies. Sophisticated software tools are being developed to help integrate data in these collaborative arrangements. These integration tools and *enterprise resource planning systems* are described in Chapter 7. Operational decisions are often the easiest to understand. They deal with structured problems over relatively short periods of time.

Tactics

As you move up in your career to project leader or department manager, you will encounter a different level of decision making, where the types of problems will depend on your specialization, but some common features will stand out. At the *tactical level*, decisions typically involve time frames of less than a year. As shown in Figure 1.14, these decisions usually result in making relatively major changes but stay within the existing structure of the organization.

Reality Bytes: Growing and Dying Industries

Industry	Revenue Change 2000-2010	Revenue in 2010 ($ million)
Voice over IP (VoIP)	194.0%	12,498
Internet Publishing	25.2%	32,573
Wind Power	16.9%	3,388
E-Commerce & Auctions	12.2%	95,005
Biotechnology	11.0%	86,971
Correctional Facilities	9.1%	34,373
Environmental Consulting	7.7%	18,153
Insurance Claims Adjusters	6.9%	57,530
Video Games	6.2%	38,622
Solar Power	2.7%	69
Video Postproduction	-24.9%	4,276
Formal and Costume Rental	-35.0%	736
DVD, Game, Video Rental	-35.7%	7,839
Newspaper Publishing	-35.9%	40,726
Mills (textile)	-50.2%	54,645
Wired Telecomm. Carriers	-54.9%	154,096
Photofinishing	-69.1%	1,603
Manufactured Home Dealers	-73.7%	4,538
Record Stores	-76.3%	1,804
Apparel Manufacturing	-77.1%	12,800

Adapted from Phil Izzo, "Top 10 Dying Industries," *The Wall Street Journal*, March 28, 2011; and Phil Izzo, "Top 10 Thriving Industries," *The Wall Street Journal*, May 16, 2011.

A manufacturing tactical-level decision might involve rearranging the work area, altering production schedules, changing inventory methods, or expanding quality control measures. These changes require time to implement and represent changes to the basic methods of the firm. What distinguishes them is that they can be made without altering the overall characteristics of the organization. For example, in most cases, expanding quality control measures does not require the firm to expand into new industries, build new facilities, or alter the structure of the industry. Much of the information for making tactical decisions comes from the transaction records that have been stored in the computer. Computer tools to help analyze this type of data are called **decision support systems (DSSs)** and are described in detail in Chapter 10.

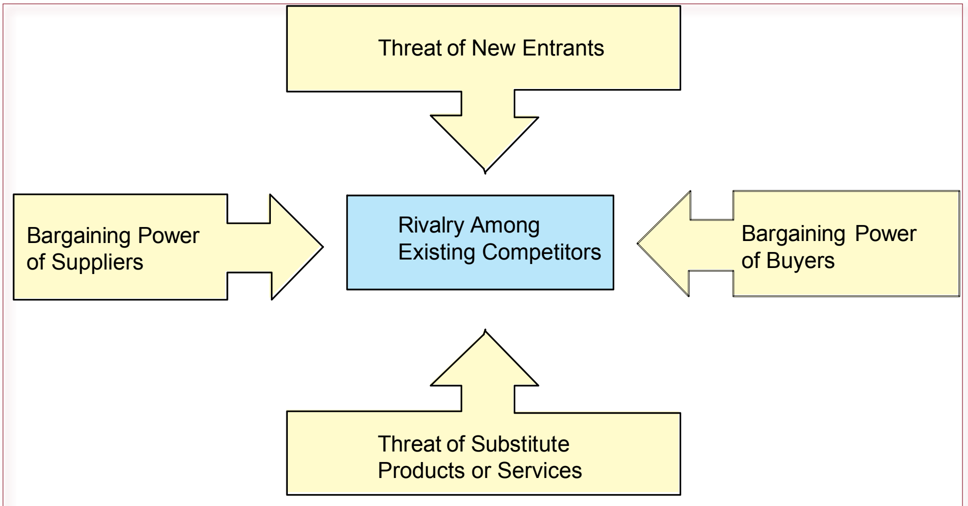


Figure 1.15

In analyzing strategies, Michael Porter focuses on the five forces: threat of new entrants, threat of substitute products or services, bargaining power of suppliers, bargaining power of buyers, and rivalry among existing competitors. Competitive advantage can be obtained by using these forces or altering the relationships between these external agents.

Other types of problems that involve more complex models occur in business. For instance, **diagnostic situations** consist of spotting problems, searching for the cause, and implementing corrections. Examples of these situations include responding to problem reports from operations to identify the cause of the problem and potential solutions. For instance, a marketing manager might be asked to determine why the latest marketing approach did not perform as well as expected. Tactical-level decisions tend to involve specialized problems and can often be solved with the help of an expert. Chapter 10 presents **expert systems (ES)** to make this knowledge more accessible to an organization.

Strategy

The next step on the pyramid moves up the corporate ladder to executive-level decisions. Although you may never be a CEO, you might be in a position to advise upper-level management about strategic opportunities—especially in small businesses. **Strategic decisions** involve changing the overall structure of the firm to give it an advantage over the competition. They are long-term decisions and are unstructured. In other words, they are usually difficult and risky decisions. Examples of strategic decisions in the manufacturing arena include building new factories, expanding to new products or industries, or even going out of business. Strategic decisions represent an attempt to gain a competitive advantage over your rivals. Because of the complexity and unstructured nature of executives' decisions, it is difficult to determine how information systems can help at the strategic level. However, Chapter 11 explores information system techniques that firms have used to gain a competitive advantage.

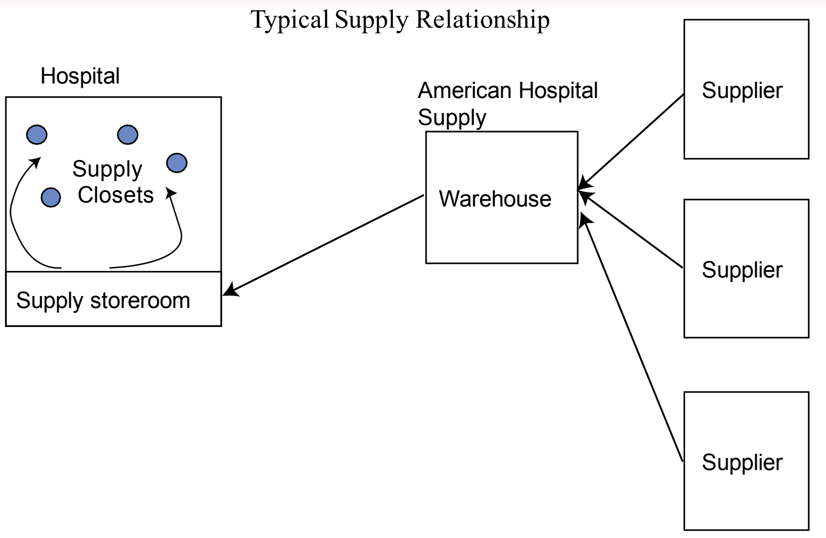


Figure 1.16

American Hospital Supply began as an intermediary that bought various medical supplies and distributed them in bulk to hospitals. The hospital distributed supplies throughout its facility and was responsible for maintaining its own inventory.

An Introduction to Strategy

Why are strategic decisions so difficult? How do you begin searching for competitive advantage? In all industries, competition is challenging. Firms are constantly searching for ways to gain an advantage over their rivals. Finding these opportunities is hard: it requires extensive knowledge of the industry, and it requires creativity. Managers also have to be willing to take risks to implement strategic options. Strategic uses of IT often involve the use of new technology and development of new software. Being the first company to implement a new idea can be risky. However, it can also bring substantial rewards.

Strategic uses of IT are discussed in detail in Chapter 11 because you need to understand the technology before trying to solve difficult problems. On the other hand, to stimulate the imagination needed for creativity, it helps to begin thinking about the basic ideas right from the start. Many cases throughout the book illustrate how firms have used technology to gain substantial advantages. These examples should help you solve other problems. If you can recognize a pattern or similarity between your problem and actions taken by other firms, the association may help you create a solution.

Searching for Ideas

Michael Porter noted that often the first step in searching for competitive advantage is to focus on external agents, or entities that are outside the direct control of your company. Porter's Five Forces model in Figure 1.15 illustrates that typical external agents are customers, suppliers, and rivals. You should also look at the role of government as an external agent. Competitive advantages can be found by producing better quality items or services at a lower cost than your ri-

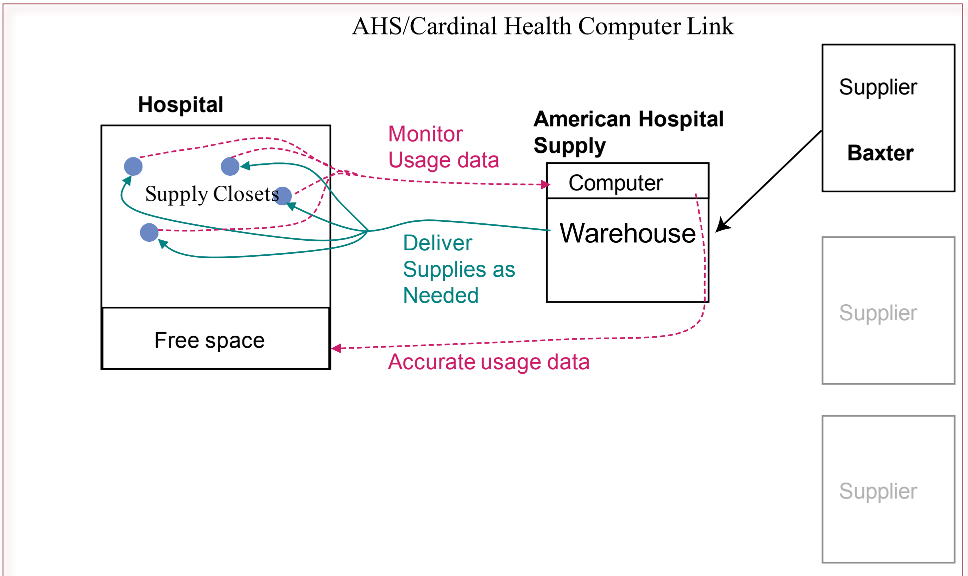


Figure 1.17

American Hospital Supply changed the industry by providing a just-in-time inventory delivery service. Supplies then were delivered directly to where they are used within the hospital. AHS could offer this system only by maintaining a computer link between supply usage and the local warehouse. The computer data also provided summary reports to management. By purchasing AHS, Baxter Healthcare gained immediate access to that sales data.

vals. Also, many firms have strengthened their positions by building closer ties with their suppliers and customers.

It is hard to find revolutionary ideas that alter the entire industry. And every firm in the world is constantly searching for that next big idea. Not only do you have to come up with the best idea, but you have to do it before someone else tries the same (or better) strategy. Then, because new strategies involve significant changes, and often high costs, you have to be able to persuade the other managers that your idea will succeed.

Strategy Example: Baxter Healthcare

Strategy is often easier to understand with examples or cases. A classic case involving IT involves management of hospitals. For a moment, picture yourself as the business manager of a medical center. Hospitals use a large amount of routine supplies such as bandages and antiseptics. Originally, they purchased them from various suppliers, held them in inventory, and distributed them throughout the hospital as they were needed. This relationship is shown in Figure 1.16. American Hospital Supply (AHS) was one of these suppliers. Then, hospitals became squeezed by initial governmental efforts to rein in and standardize medical costs. One consequence of these early controls is that hospitals and physicians no longer controlled the length of stay for patients. Consequently, hospital managers were forced to find ways to reduce costs. To gain an advantage over their competitors, AHS created a new system and made an offer to the hospital managers. AHS

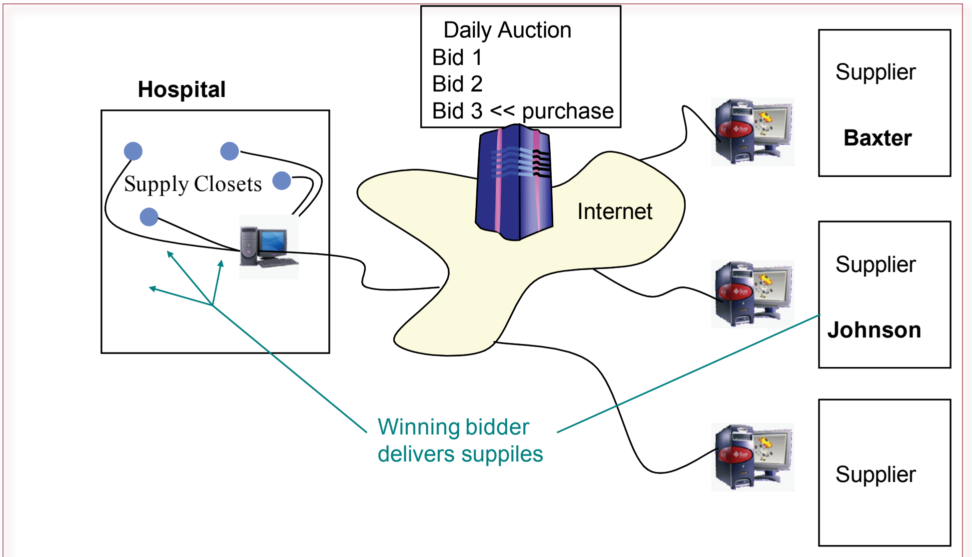


Figure 1.18

Moving to the Internet. Today, competition could be increased by connecting the hospitals and suppliers through a B2B Internet auction. The daily hospital data could be listed on a private auction site, and supplier computer system would automatically bid for each job. The winning bidder would deliver supplies as usual, but different suppliers might win the bidding each day.

placed computer terminals in hospital locations where the supplies were used (emergency, operating rooms, nursing stations, etc.). As shown in Figure 1.17, these terminals were connected to the AHS computer.

As hospital personnel removed supplies, they recorded them on the terminals. The computer kept track of the amount of supplies in each location. A list would be printed at the warehouse, and drivers delivered the necessary supplies to each location in the hospital. Monthly usage statistics were sent to the hospital.

The hospital gained because the facility did not need to maintain extra inventory, which saved money and space. Fewer hospital employees were required, because the supplies were delivered directly to the needed locations. Additionally, the hospital received detailed usage records.

To offer this service, AHS incurred higher costs—largely the cost of creating and maintaining the information system. What did AHS gain in return? As long as it was the only company offering this service, AHS gained a competitive advantage by providing a new service. Hospitals were more likely to choose AHS over the rivals. But what would happen if a competitor created a similar system? Would the hospitals stay with AHS or switch to the rivals?

Although the answer depended on the prices, hospitals had a strong incentive to stay with AHS. They would encounter various **switching costs** if they chose another supplier. For example, daily operations would be disrupted while the system was changed. Employees would have to be retrained to use the new system. Managers who used the monthly usage reports would have to adapt to the new system. A rival would have to offer strong price advantages to overcome these costs.

In 1985, Baxter Healthcare, a large manufacturer of supplies, purchased AHS. Of course, over time Baxter had an incentive to cut its costs to maintain higher profits. In the process their delivery service might suffer. Some hospitals apparently experienced problems and returned to in-house stock rooms to eliminate shortages of basic supplies. In 1996, Baxter spun off Allegiance Medical Supply Corporation as a separate unit. Today, Allegiance is a subsidiary of Cardinal Health, one of the three main health care distributors in the United States (Owens & Minor and McKesson are the other two).

With the expansion of the Internet, as shown in Figure 1.18, the entire medical supply chain industry is attempting to build an online Web service system. Ideally, miniature electronic auctions would take place each day. The supplier systems would automatically monitor the hospital needs and compete to resupply them. Most of the monitoring and bidding could take place automatically on the Internet. The best bid would win each day, and the hospitals would not be tied to a single supplier. Yet all transactions and payments would be automated, holding costs down for all parties.

Cloud Computing

As a consumer, you have certainly seen the increasing importance of Web-based technologies, including sales, news and entertainment, communications, and social network interactivity. Many of these same concepts can be applied to information technology within businesses. Instead of running applications on personal computers, all of the data and services can be moved to Web-based servers. Managers could access the data through portable devices including laptops, tablets, and cell phones. Centralizing the Web servers provides the ability to control and monitor the data and software. It also makes it easy to provide backups, duplicate facilities, and robust Internet connections. In some cases, services might be provided by other companies. The Internet is often pictured as a cloud because it has imprecise boundaries. So running operations from Web servers is often referred to as **cloud computing**.

Many aspects of MIS can impact and benefit from cloud computing. Each chapter in the book looks at various issues and examples of how Web-based servers can change the way companies deal with information systems.

Summary

Information technology is altering jobs, businesses, and society. Managers who understand and use this technology will be able to improve companies and advance their personal careers. Studying technology means that you must also study businesses and understand how they operate. Information systems consist of hardware, software, people, procedures, and collections of data. These components work together to provide information and help managers run the firm, solve problems, and make decisions. Studying information systems will also teach you to analyze business operations and solve problems.

The role of a manager is changing, but at a basic level all managers spend time organizing resources, planning, motivating workers, and communicating with other employees and managers. Several business trends will affect individual jobs, business operations, and society. Important trends include specialization, management by methodology and franchising, decentralization, the increased importance of small businesses, the use of temporary workers and consultants, the growing international scope of business, and the rise in service-oriented businesses. Information technology is used to support these trends and provide new management alternatives.

As is true of many problems, management and information technology can be studied by breaking them down into smaller pieces. The three basic levels to management are operations, tactics, and strategies. The operations level is concerned with day-to-day operations of the firm. Tactics involve changes and decisions that improve operations but do not require a major restructuring of the firm. Strategies are designed to give a firm a competitive advantage.

Strategy typically involves examining external forces: rivals (competitors within the industry), customers, suppliers, potential new competitors, and potential substitute products or services. Information technology can be used to strengthen links strategically between customers and suppliers. It can also be used to create new products and services and to improve the quality of the operations.

A Manager's View

How do you manage and control a firm? In the 1950s, an army of back-office workers and managers were required just to record the basic data for the firm. Today, a good information system helps you manage a small company or a large empire with fewer workers. The workers that remain are those who use the technology intelligently to solve business problems. Regardless of your area of expertise, as a manager you have to be able to analyze and interpret data. You also have to communicate and share your work with teammates. Information technology provides the tools you need to solve common business problems.

Key Words

B2B
B2C
cloud computing
data
database
decision process
decision support system (DSS)
diagnostic situation
dot-com
e-business
e-commerce (EC)
enterprise resource planning (ERP)
expert system (ES)
hardware
information
information technology (IT)
knowledge
management information system (MIS)
people
procedures
reengineering
software
strategic decisions
structured decisions
switching costs
transaction processing system
wisdom

Web Site References

General Searches	
Ask	www.ask.com
Bing	www.bing.com
Dogpile	www.dogpile.com
Google	www.google.com
Yahoo	www.yahoo.com
Yippy	www.yippy.com
People and Businesses	
Anywho	www.anywho.com
Infospace	www.infospace.com
Knowx	www.knowx.com
ChoicePoint	www.choicepoint.com
Securities and Exchange	www.sec.gov
SuperPages	www.superpages.com
Switchboard	www.switchboard.com
Whitepages	www.whitepages.com
Reference	
Britannica (encyclopedia)	www.britannica.com
CIA World Factbook	www.cia.gov/cia/publications/factbook
Dictionary	www.dictionary.com
Encarta (encyclopedia)	www.encarta.com
FedStats	www.fedstats.gov
Translation dictionaries	www.freedict.com
Translate/Google	translate.google.com
Wiktionary	www.wiktionary.org
Wikipedia	www.wikipedia.org
Wolfram Alpha, math and science	www.wolframalpha.com

Review Questions

1. What is the main purpose of MIS?
2. How is MIS different from studying personal productivity tools?
3. Describe the five components of a management information system.
4. Why do students who are not MIS majors need to study MIS?
5. How important is the Internet in sales?
6. How do you know if you are buying the correct level of technology?
7. What are the roles of managers in a modern company?
8. Describe how seven basic trends in today's business environment are related to MIS.
9. Why is re-engineering important in business?
10. What are the three main management decision levels, and why are they important to know?
11. How does strategy involve "external" organizations?
12. What is cloud computing?

Exercises

1. Identify a job that has minimal use of information technology. Explain why the job might not need technology or what type of technology would be needed to improve productivity in the job.
2. Talk to at least three people and ask them how often they get a new cell phone and a new computer. Compare the answers and comment on any differences.
3. Choose a company and describe three decisions that must be made: one at the operations level, one tactical, one strategic. Be specific.
4. Choose a company and read its two most recent annual reports. Summarize the company's strategy and goals for the coming year.
5. As an entrepreneur, you decide to open a fast-food restaurant. You can purchase a franchise from one of the established corporations (as discussed in the McDonald's case) or create your own restaurant. Compare the choices by identifying the decisions you will face with each approach. What data will you need to collect?
6. Assuming you run a small business, find two Web sites that enable you to hire contract workers online. Provide a brief list of the types of tasks that are offered on the sites.
7. Review business magazines, newspapers, and Web sites. Find two organizations and identify a specific business problem that each one faces. Classify the problem as operations, tactics, or strategies.

8. Identify the most likely decision level for each of the following situations.
   a. A manufacturing firm lays off 100 workers.
   b. A restaurant completely changes it menu.
   c. A Web site begins accepting Google payments.
   d. A company builds an iPhone-based app to provide complete customer and order data to its salespeople.
   e. A California farmer tears out his fields of grape vines and plants olive trees.
   f. A large retail chain implements a new computer system to analyze sales by time and day and uses it to alter prices in every store.
   g. A manufacturer creates a computer system to evaluate workers in terms of productivity and cost and uses it to give bonuses or fire workers.
9. Find one company that is using information technology in a way that surprises you. Briefly explain what the company does and why it seems different or new. (Check places you go, try the Wall Street Journal, Computerworld, or CIO Magazine.)
10. Which geographic region of the world has the most Internet users and why?

Technology Toolbox: Searching

11. What was the name of the space shuttle that took the last flight?
12. What is the approximate ratio of cell phones to landline phones in Ethiopia?
13. How many singers have covered (recorded) John Lennon's song *Imagine*?
14. How much profit did Exxon Mobile earn in 2010?
15. Who is the main executive producer of the TV show *The Big Bang Theory*?

Technology Toolbox: Government Data

16. Find monthly unemployment data for at least five years and display it in an appropriate chart.
17. Compare the most recent population by state.

Technology Toolbox: Spreadsheets

18. Create a spreadsheet to record current sales and forecast future sales as a 4 percent increase.

	increase	4%
Region	**Sales**	**Forecast**
Midwest	132	
Southwest	651	
Northeast	478	
Southeast	391	
	1652	

19. If you have Excel 2010 or later, create the following spreadsheet and chart that consists of fictional data evaluating three search engines. The weighted average is the total of the response value in the cell times the point value on the first row, where the total is divided by the sum of the number of responses.

	5	4	3	2	1		
	SA	A	N	D	SD	Wtd Avg	
Google	71	37	12	5	1	4.365	
Bing	65	43	27	8	4	4.068	
Yahoo	32	55	45	32	12	3.358	

Teamwork

20. Each team member should find and select a new computer that could be used by a typical manager in a business. Combine the data from each person into a single spreadsheet. Compute the average price, drive size, and memory size. As a group, select one of the computers that could be used as the standard for each person in the group.

21. Choose an industry. Have each team member select one company within the industry and find the number of employees at that company for the two most recent years. Compare the total number of employees to see if the total has increased, and to see which firms are growing the fastest. Compare the industry results to those in the rest of the class.

22. As a team, find an example of companies that have recently merged. Identify potential reasons for the merger and how each company might benefit (or suffer) from the merger.

23. As a team, choose a specific company and identify at least one decision that has to be made at each of the management levels. What data would be needed to make the decision? Briefly explain why the chosen level applies to each decision.

Rolling Thunder Database

24. Install the Rolling Thunder Bicycles database. Look through the various forms. List each of the main forms and briefly describe the purpose of the form.

25. Using the Rolling Thunder help files or the description available on the Internet site, describe the goals of the firm and outline the basic operations.

26. Using Internet sources, identify the competitors to Rolling Thunder Bicycles.

27. Using Internet, financial, and government sources, estimate the size of the market (total sales and number of bicycles) for quality bicycles.

28. Locate at least five sources for additional information about bicycles and bicycle components on the Internet. List and briefly describe the sites.

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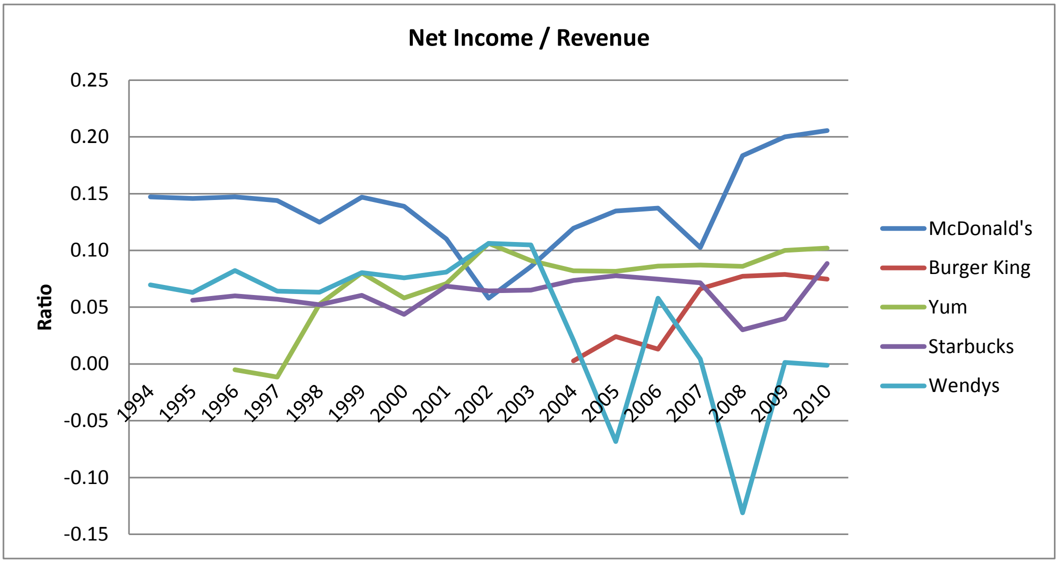
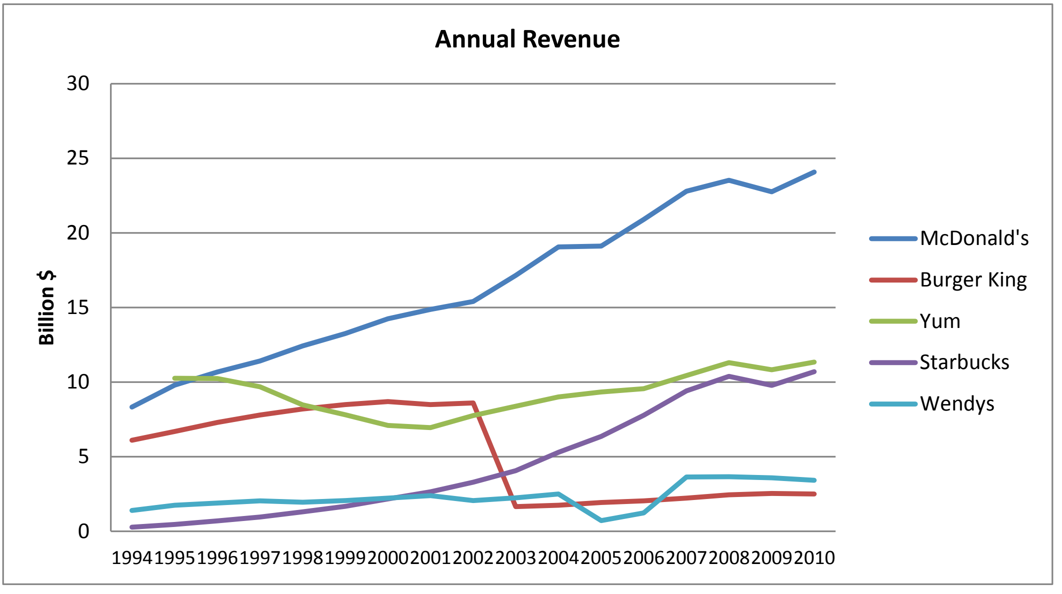
Cases: The Fast-food Industry

The Industry

What do customers want? Look at the sales for the major fast-food restaurants, and you see increases by many companies. Look at the Standard and Poor’s restaurant stock market index, and investors agree. In 2003, the index was up 37.5 percent, compared to a 24.8 percent rise in the S&P 1500. Since an aging, wealthier population favors dining in full-service restaurants, the casual-dining sector is gaining share from fast-food restaurants. This trend is projected to continue as the population ages. Many restaurant chains, especially those in the fast-food sector, will increase their focus on healthy food initiatives to attract customers and reduce the impact of obesity-related lawsuits. Increased diversity in menus will help to reduce the dependence on industry price discounting, enabling operating margins to further expand. The introduction of new restaurants will likely slow in the over-stored U.S. fast-food market. Most fast-food restaurants are looking to international expansion to lead to growth. But, fast-food restaurants cannot stand still. Many radically expanded their menus, both to target higher-mar-





gin threats such as coffee and smoothies, and to add healthier snacks. And when the recession hit in 2007, fast-food restaurants were able to provide meals at substantially lower costs than full-service restaurants. In the ensuing couple of years, fast-food chains increased sales while many high-end restaurants closed down.

During the past two decades, the percentage of U.S. food dollars that has gone to eating out has increased substantially. A greater percentage of people, particularly women, are working more, leaving less time available to prepare food at home. Overall sales have increased based on three factors:

- The opening of new stores.
- Higher contributions from older restaurants.
- Acquisitions of other chains or selective sites.

But over the past several years, fast-food sales gains have lagged those of the full-service sector, due in part to ferocious competition, fierce price discounting, and reduced same-store sales and profitability. In January 2003, both McDonald's and Burger King changed management teams. Both companies have focused on rebranding efforts to recast their dowdy image and less reliance on price discounting as a means to drive traffic. In 2004, the CEO of McDonald's died of a heart attack, but it is likely the changes he instituted will continue.

What Do Customers Want?

Most of the fast-food restaurants have tested a variety of options to find what customers want. Originally, McDonald's was successful because it promised the same level of service and quality regardless of where you traveled. But incomes increased and health became an important issue. Do customers still want the same things? How can the big fast-food chains identify what customers want? How can they respond quickly enough?

New Concepts: Quick Casual.

The first generation to grow up with fast food has now reached their mature, high-income years. To meet their needs, "quick casual," limited, self-service restaurants are geared toward adults. They feature "upscale" menus, with more healthful items such as gourmet soups, salads, and sandwiches. In some quick-casual units, workers take orders from behind the counter as customers proceed in a line toward the register. In others, they take orders at a counter where customers pay for the food, which is then prepared and delivered to the customer's table. Checks, averaging between $6 and $9, are higher than in traditional limited-service units, but lower than in full-service casual dining restaurants.

The most successful and most visible of the quick-casual chains is Panera Bread Company. An operator of bakery/cafés, system sales now surpass $800 million. The company plans to add another 100 to 150 units annually over the next several years.

Focus on Health.

The American culture has become significantly more health-conscious and litigious over the past decades. This culture has resulted in lawsuits focused on the responsibility for obesity-related health problems faced by consumers, particularly children. Plaintiffs have sought remedies such as menu changes, nutritional labeling, advertising restrictions, and monetary damages. In response to this strong customer demand, many restaurant chains have begun to make significant changes in their menu offerings. Applebee's International signed a deal with Weight Watchers International Inc. in July 2003 to develop a menu for diet-conscious individuals. In February 2003, Darden Restaurants opened its first Seasons 52 unit, a test concept offering low-calorie menu items.

The fast-food industry has introduced even more dramatic changes, perhaps because it has the most to lose from consumer perceptions of the healthfulness of its food offerings and from potential lawsuits. In August 2003, Wendy's announced that it would promote four meal combinations from items already on the menu that would have less than 10 grams of fat. Wendy's also added another salad offering to its menu. Burger King and Jack in the Box have focused on salad, chicken, and turkey offerings to revamp their menus.

McDonald's has developed a wide range of "Healthy Lifestyle" programs, including the addition of menu offerings that the company believes will attract health-conscious consumers. It has also developed new Happy Meals that include yogurt, milk, vegetables, or fruit, depending on the end market. In 2002, McDonald's changed its cooking oils to reduce the amount of trans-fatty acids in its fried foods. In June 2003, it phased out animal-growth-promoting antibiotics in its meat supply. McDonald's has also sought to promote nutritional education and awareness among its customers. In May 2003, the company formed its Global Advisory Council on Healthy Lifestyles, consisting of experts such as doctors, educators, and athletes in the areas of fitness, nutrition, and active lifestyles. The group is commissioned to help guide the company toward activities that promote balanced, healthy lifestyles among its customers. McDonald's has also begun to collaborate with the World Health Organization and the U.S. Department of Health and Human Services to educate consumers on the importance of nutrition and fitness. The company has educated consumers by printing brochures directing them to the nutritional information on its corporate Web site.

The Future

The restaurant industry generally depends on the economy. When people work, they have less time and more money, so they vote for convenience. As long as costs stay low, the industry should continue to do well. Costs are heavily dependent on labor and food. Companies tend to lock in food costs for up to a year, so they are less affected by short-term swings in prices. Labor costs depend on the overall economy. The question of what customers want is difficult to answer. And the answer changes over time. Information systems can help identify sales patterns. They can also help control costs and reduce order lags with suppliers. But, analyzing the data requires a keen eye and experience.

Case: McDonald's

What do customers want? John Gusapari in *The Customer Connection* suggests that one goal is to meet customers' expectations. You accomplish this by creating value. Creating quality is not just a matter of reducing defects but of providing customers with something they value. McDonald's (ticker: MCD) has a clear definition of customer needs and expectations. Its formula is QSC, quality, service, and cleanliness (Band 1989). Transaction quality, defined from a customer's perspective, means paying for a product or service in a way that makes the customer feel good about doing business with a company.

According to Harry Beckwith (Beckwith 2003), customer definition is essential to success in marketing. Beckwith viewed McDonald's as an example of a classic, but simple, excellent service model. However, he feels that they have recently taken their eye off the ball, forgetting their formula for success. Beckwith feels their mistake is that they have been thinking that fast food is a food business. Beckwith focuses instead on the "fast" part of the definition: It is a time and convenience business. In Beckwith's opinion, McDonald's has made the menu choices too complex costing customers too much time. Beckwith does not feel that people go to McDonald's for the menu.

Corporate Summary

McDonald's Corporation serves more than 64 million customers daily from 32,737 fast-food restaurants in over 115 countries. In 2011 there were 14,000 restaurants in the United States and 17,614 in other countries. McDonald's maintains its competitiveness through substantially uniform menus and standard operating processes. The company has experimented with expansion through partner brands in additional market segments including Boston Market, Donato's Pizza, and, (in the UK) Pret A Manger. McDonald's sold its Chipotle Grill in 2006 for $300 million. McDonald's operates all of its restaurants under joint venture agreements. In 2010, McDonald's annual report showed the mix was (although only company stores are recorded as revenue):

Restaurant	Sales ($ billion)	Number
Company-operated	$16,233	6,399
Franchise + Affiliated	$61,147	26,338
Total	$78,380	32,737

Systemwide sales were $64 billion in 2010, accounting for $24 billion in revenue for McDonald's. The company is targeting sales growth rates of 3-5 percent a year. U.S. sales increases were largely driven by breakfast items and coffee, and the introduction of wraps as a menu item. International business contributed 66 percent of revenue in 2010 and 50 percent of operating income, compared to 45 percent in 2003. McDonald's 2006 Annual Report notes the existence of 550,000 restaurants in the U.S. with $365 billion in sales. McDonald's restaurants represent 2.5 percent of the total and 7.4 percent of the sales. Key factors in the performance of the company include

- The ability to forecast trends, demographic changes, and food preferences.
- The selection of menu items and product mix.
- The ability to improve day-to-day restaurant operations and hire workers.
- The ability to identify new franchisees.

To focus on the restaurant business, in 2009 McDonald's sold its interest in the Redbox company for $140 million. In 2008, it sold its interest in the UK Pret A Manger company for $229 million. However, many McDonald's stores still have Redbox movie rental kiosks.

Turnaround Under Way

Jim Cantalupo, one of the architects of McDonald's highly successful worldwide expansion in the 1990s, was lured out of retirement to run the company. He assembled a youthful and energetic management team, led by president and chief operating officer Charles Bell, to revamp the company's fortunes. Under this new leadership, the company embarked on a strategic plan to return to positive sales growth and income trends. To accomplish this goal, the company shifted its focus away from expansion and toward the improvement of existing operations. Tragically, Jim died of a heart attack in April 2003.

McDonald's began to address concerns that its menu had become stale and irrelevant to today's consumer. McDonald's made new product introductions, including salad offerings, the McGriddle breakfast sandwich, and increased Happy Meal options. Even though management believes that excessive price discounting has diminished the company's brand image, the company plans to maintain the 99-cent Value Meal offering. In relation to the brand image, the public's perception of the quality, service, and cleanliness at McDonald's units has suffered over the last several years. The company has lagged behind its peers in consumer attitude toward these areas. To improve overall customer satisfaction, the company has refocused on its quality, service, cleanliness (QSC) program. This program gauges performance at each location through customer satisfaction studies and "mystery shoppers," who pose as customers and score each unit's performance in various categories. The company has also taken a harder line with franchisers who do not perform to expectations.

McDonald's must also reinvigorate the company's franchise base. Franchisees run more than 70 percent of McDonald's 31,000 restaurants worldwide and account for a similar level of systemwide sales. In recent years, many franchisees have been demoralized by declining profits caused by company-mandated discounting, a proliferation of stores that has cannibalized individual store sales, and the overall lack of a coherent national advertising program. Retaining hardworking, entrepreneurial store owners is paramount to reinvigorating the company's health.

McDonald's began to reap benefits from its new strategies in early 2003. The company had seen its profitability deteriorate in the United States during 2001 and 2002 because of operational shortcomings and sales trends that were significantly below the industry average. In the second quarter of 2003, driven by new product offerings and improved marketing effectiveness, same-store sales jumped 4.9 percent, year to year. While these sales results are only an important first step in reviving McDonald's image, the company must show tangible improvement in its customer satisfaction scores to maintain momentum. New products may lure customers through the doors, but high degrees of customer satisfaction are often the key to keep them returning.

CEO Jim Skinner is pushing for innovation in new products, but is also focused on "maintaining fiscal discipline and tight controls on company expenses" (2006 Annual Report). 2006 was a good year for McDonald's with a 7 percent global increase in sales and improved prices of the stock. However, McDonald's used the proceeds from the sale of its Chipotle franchise to repurchase shares—contributing to the increase in stock prices.

Since 2006, McDonald's has averaged four percent increases in sales revenue at U.S. stores. Despite the recession, McDonald's has grown—even faster than its nearest competitors. The company plans to push its advantages—with plans to remodel or rebuild almost half of its 14,000 stores. Key elements in the rebuild include doubling the number of drive-through lanes and redesigning interiors that encourage people to stay longer (Jannarone 2011).

Enhancing Information Technology through Project Management

To improve the project success rates on information technology projects, McDonald's has developed an apprenticeship program for prospective project managers, combining classroom theory, on-the-job learning, and support from mentors. McDonald's is accomplishing this program in association with the Computer Technology Industry Association (CompTIA), six other companies, and a $2.8 million grant from the Department of Labor. The goal is to develop a National Information Technology Apprenticeship System, aimed at building skills and credentials around specific business-technology functions.

The grant enables CompTIA to build four career tracks in areas that it feels are prime for IT apprenticeships: IT generalist, project manager, security, and database. The grant also provides funds to implement Web-based processing of applications and certification. Over the next five years, CompTIA has committed matching funds of nearly $3.8 million to develop the system's infrastructure, skill standards and work processes, and marketing strategies to encourage large-scale private sector adoption.

The Labor Department awarded CompTIA a grant of $550,000 through December 2002 to assess whether apprenticeships would work in the IT industry and to develop one apprenticeship track for the IT generalist. Success with that led the Labor Department to award a $475,000 second-round grant through December 2003 to develop additional apprenticeship tracks, including IT project management, and to test them in pilot companies such as McDonald's. The latest round of funding enables the Labor Department to expand on these original efforts.

Using Technology to Improve Operations

Day-to-day operations are critical to McDonald's restaurants. Hyperion, a software company that sells analytical tools, observes that reducing service time by six seconds increases sales revenue by one percent (Vance 2004). HyperActive Technologies, a specialty company from Pittsburgh, created HyperActive Bob, a tool that helps estimate fast-food sales for the next 10 minutes. The tool uses past sales data and cameras to evaluate traffic entering the restaurant. The computer display tells the grill cooks how many high-volume items to start cooking. When the order arrives, it is pulled right off the grill. In one trial, the system noticed fewer cars entering the drive-through than expected and it told the grill cook to hold back. The cook, with three years of experience, wanted to ramp up production for the lunch hour. The manager convinced him to listen to Bob and wait. It turns out a ruptured gas line on the road blocked traffic, and the real-time information analyzed by Bob was correct. In 2006, McDonald's rolled out a new point of sale system to 8,400 restaurants. The system created improved order accuracy and speed of service.

Sometime around 2001, McDonald's Corporation started the Innovate project that was designed to build an intranet to collect detailed data from every restaurant franchise around the globe and transfer data to corporate headquarters. The system would have integrated 30,000 restaurants in more than 120 countries. Presumably, it would have given McDonald's detailed records on sales and operations. According to SEC filings in 2003, the project was cancelled after spending $170 million on consultants and initial implementation (McDougall 2006).

Dee Crawford runs five McDonald's restaurants. She notes that "Change is a part of our business, to keep up with customer demands, and there have been a lot of changes." In 2010, her restaurants had more than 100 items on the menu—far more than in the past. (Jargon 2010). The expanded menu has helped McDonald's increase same-store sales for 30 straight quarters since early 2003. Even during the worst of the recession in 2008, same-store sales increased by 6.1 percent. Introducing high-end coffee has increased sales in some stores and struggled in others, and the machines cost $100,000 per store. The company has learned that snack wraps and other items often eaten between traditional meals have become the fastest selling items. Most stores have increased their hours to attract more non-traditional traffic. With the larger menus, a corporate distribution center automatically handles inventory and restocks stores two or three times a week.

The 2010 annual report notes that the company uses a "strategic menu pricing tool that optimizes price, product mix, and promotions." Several newer restaurants use electronic display boards to digitally display the menu and prices. Among other things, the tools enable the restaurant to quickly alter prices. The company also plans to introduce a new point-of-sale system beginning in 2011. In some locations, particularly Europe, the company is introducing self-order kiosks. In a few locations, drive-through productivity is improved by having employees with hand-held terminals take orders by walking down the drive-through lane.

In 2010, McDonald's worked with Nintendo to develop a DS-based game to help train new workers. Most restaurants have relatively high employee turnover, so they are constantly training new workers. The system reportedly reduced training time from 45 to 24 hours and eliminated the need for human trainers for the initial training (Perkins 2010).

Application of the Internet to Solving Business Problems

One of the ways that McDonald's has used the Internet is to provide information to customers to deal with the fat content of their meals. While this is in some way a response to attorneys and consumer groups that have criticized the industry for fattening America, McDonald's is using Internet technology to better disseminate information about the nutritional properties of their menu items. In 2003, McDonald's revamped its www.mcdonalds.com Web site to better explain the nutritional values of the chain's foods.

Among the most graphically sophisticated nutrition tools on the Internet, "Bag a McMeal" enables users to drag up to five McDonald's menu items from pull-down lists into a virtual bag. Once completed, the users receive a cumulative nutrition profile covering calories, fat, cholesterol, and sodium, among other information. A "Customize an Item" feature enables consumers to obtain a nutrition profile for a special order, such as a McChicken sandwich without mayonnaise or a Big Mac without cheese or sauce. "Bag a McMeal" uses multiple pull-down lists and drag-and-drop functionality to generate a nutrition profile for a complete meal of up to five items. The goal is to provide additional educational resources to demonstrate the range of options and service sizes available to make it easy to fit McDonald's into a balanced diet.

According to McDonald's representative Lisa Howard, the Web-surfing public has found value in the dynamic nutrition databases. "There are from 160,000 to 200,000 unique visitors to the nutrition section of McDonalds.com each month," Howard said. "We've seen it spike [upward]" since the new Web tools were put in place, she added. According to Howard, "We continue to look at new and innovative ways to communicate with customers, like in store kiosks" (Brewin 2003).

Reaction to the Web-based nutrition information has been critical. "If [the chains] were really serious about doing a better job at giving consumers information, diners would have that information at the point of decision in the restaurant," said Jeff Cronin, director of communications for the Washington, D.C.-based Center for Science in the Public Interest. "Now the [nutrition] brochures are hard to read and hard to find and sometimes altogether absent. Few consumers would leave their place in the drive-thru or counter line to find and read a poster with nutrition information before ordering, and many fewer are likely to go to a Web site before making a decision." National Restaurant Association officials and representatives of some other trade groups have countered this argument by asserting that restaurateurs provide what consumers want, not what restaurateurs think consumers should eat. They believe menu board notices are unnecessary, since many chains already provide interested consumers with printed brochures or Web site pages containing nutrition information for regular menu items.

Given the debate about practicality and accessibility, information about nutrition can be stored in large, centralized, and easily updated databases that many consumers can tap through the Internet. Such data can be presented in ways that enable Web surfers to personalize searches and "drill down" through multiple layers of details to get as little or as much insight into a topic as desired. Many restaurant companies have ignored such dynamic Internet presentation plans in favor of merely presenting at their Web sites the same nutrition information tables contained in printed brochures.

McDonald's may be considering ways to leverage its Web site technology in such a fashion, company spokeswoman Howard said. "We continue to look at new and innovative ways to communicate with customers—that is certainly something we might look at."

Of course, using the Web also opens up more holes for hackers. In December 2010, McDonald's reported that someone had broken into the company's databases and stole information about customers (Perez 2010). Much of the data was collected by Arc Worldwide, a company that develops and coordinates promotional e-mail messages for McDonald's. The data was basically personal information provided by customers and did not include SSN or financial data.

McDonald's also runs a Facebook page which it basically uses as a Web site to provide basic data but also to collect comments from users. The McDonald's site is also one of the first to use Facebook's location feature. It enables people to "check in" at a location and receive coupons or promotions for the nearest McDonald's restaurant (Gannes 2010).

Implementing Wireless Technology

Many restaurants view the public-access Wi-Fi "hot spot" technology as essential for attracting customers. But what is still unclear is how much businesses can charge customers to use the Wi-Fi links—or whether they should simply provide the Internet and e-mail access capabilities for free with the hope that increased sales of food, drinks, and other products will offset the cost of the technology.

McDonald's launched a Wi-Fi pilot project at 75 restaurants in the San Francisco Bay area in mid-2003 through a deal with Austin-based Internet access provider Wayport Inc. Mark Jamison, vice president of business strategy and development at McDonald's, said the company would use the San Francisco trial and similar ones in Chicago and New York to evaluate potential pricing models for the service and Wi-Fi technology's ability to attract customers. The end result is that McDonald's plans to equip several hundred restaurants in the United States with Wi-Fi connections by 2004. McDonald's charges $4.95 for two hours of Wi-Fi access at the San Francisco locations, but customers who buy a meal can use the technology for free. By the end of 2006, 15,000 restaurants worldwide had wireless access.

But will customers really go to a restaurant because it has wireless access? Consider the opinion of Matthew Nuss of the Valencia Group, a Houston-based hotel operator: "Wireless, in our opinion, is the next running water. It has become part of the infrastructure of a hotel" (Wright 2003). On the other hand, McDonald's is using an outside company (Wayport) to set up and run the Wi-Fi operations. McDonald's is also benefiting from the technology. It is using the same Internet connection to run its cashless payment and credit card systems. Basically, it is turning communications with the stores into a revenue-generating operation (Brewin 2004). David Grooms, VP of IT at McDonald's noted that "It gives us a platform to use wireless applications within the restaurant." It turns out that 25 percent of the Wi-Fi traffic is produced by gamers using Nintendo DS systems (Mitchell 2007).

Seattle-based Starbucks Corp. launched Wi-Fi service in its U.S. cafes in August 2002 and offers access in about 2,000 locations. Users have to sign up for the service with Bellevue, Washington-based T-Mobile USA Inc., whose prices start at $19.99 per month. Lovina McMurchy, director of Wi-Fi business and alliances at Starbucks, said the company plans to stick with that approach. But she added that Wi-Fi hot-spot deployment is "a learning experience" for businesses and said it's hard to tell how different pricing plans or free services will play out. At this point, a lot of companies are still just "dabbling" in Wi-Fi through pilot projects, McMurchy said.

In 2009, McDonald's in partnership with AT&T opened up the Wi-Fi and offered it for free. The goal was to encourage customers to sit around longer and buy more products—particularly higher-profit margin drinks including coffee and fruit smoothies. CIO David Grooms noted that "We're becoming a destination and free Wi-Fi just naturally fits. This is another long-term investment that we see helps McDonald's stay relevant as a brand in the marketplace." McDonald's is now a significant Wi-Fi provider in the U.S., delivering one out of six hot spots (Ziobro 2009).

Questions

1. How does McDonald's use technology to learn what customers want?
2. How does information technology reduce management costs?
3. Has the Wi-Fi implementation been successful?
4. Does the franchise model make it more difficult to implement information technology solutions? Explain.
5. Is it more important for information technologies to reduce costs or provide new services?

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Case: Burger King

Burger King (private) is the second largest fast-food chain in the United States, with more than 12,000 locations 2010. For the year ending in June 2006, Burger King's annual report estimates that McDonald's, Burger King, and Wendy's account for 73 percent of the fast-food sales in the United States, with Burger King accounting for 15. Burger King has encountered difficulties over the last few years. According to *Nation's Restaurant News (NRN),* the company's market share among quick-service sandwich chains dropped from 15.03 percent in 2000 to 13.68 percent in 2002. The comparative revenue from the annual reports shows slight increases for BK sales after 2003, but far below that of McDonald's.

In the fall of 2002, Burger King was sold to a private investment group for approximately $1.5 billion. Many analysts believed the change in ownership would improve the chain's management focus and vision, increasing its competitiveness in the marketplace. Brady Blum, formerly a senior executive of Darden Restaurants Inc., was hired as CEO to engineer a turnaround. Burger King now seeks to recast its brand image by focusing on its grilling processes and retooling its menu, while downplaying its previous emphasis on discounts. The new strategy has yet to provide the desired results, however. The chain has acknowledged that negative same-store sales trends continued into the first six months of 2003. From 2003 to 2006, the chain experienced a drop-off in franchisees renewing their 20-year agreements. To renew a contract, franchisees have to pay a $50,000 fee and upgrade their restaurants to current standards—typically paying around $325,000. Fewer than 50 percent of the franchisees were able to or willing to pay the costs for a full renewal. BKC also experienced problems collecting royalty payments from many franchisees and the company initiated a program to assist strong stores and help close the weaker ones. In 2006, BK went public again with an IPO. In 2010, BK returned to private ownership when it was purchased by 3G Capital (Web site history). Less than a week after the takeover, Raj Rawal was replaced as CIO by Heitor Goncalves (Betts and King 2010). Previously, Goncalves had worked Anheuser-Busch InBev, both as director of Mergers and Acquisitions and as a vice president of "rewards and target setting."

Standardized Point-of-Sale Terminals

New point-of-sale (POS) terminals from NCR Corp. have provided more than 130 Burger King restaurants in Canada with a standard method of order taking and data entry. Burger King Corp. has already installed NCR's Compris food service software, support services, and RealPOS 7454 terminals in more than 600 company-owned restaurants in the United States. It is wrapping up deployment in its 259 company locations in Canada, the United Kingdom, and Mexico. The goal of the deployment is to streamline equipment across corporate-owned restaurants around the globe, according to Michael Lingswiler, director of technical services with Burger King. "The drive behind this is standardization. The NCR platform provided the functionality and given where they are in the market are able to provide for future releases" (Hilson 2003).

A standard interface for all restaurants enables changes in the menu or special promotions to be easily linked with the corporation's back-end systems. Training can be standardized and deployed across all regions of the company. Simplicity, durability, and environmental friendliness are important in these fast-paced environments. Prior to the standardization effort, Burger King had a mixture of NCR and non-NCR equipment in their restaurants. Typically, these terminals have a life cycle of about three years. While franchise restaurants are responsible for their own POS hardware/software selections, they often adopt the corporate-owned model for ease in purchase and maintenance.

In its 2006 Annual Report, Burger King noted that it had selected three primary POS systems as preferred providers, but it does not require franchisees to choose a particular hardware and software package. Data collection from franchisees is still handled manually. By 2010 (annual report), the new POS systems had been installed in all company-owned restaurants and 57 percent of the franchises. All restaurants are required to install the new POS before January 1, 2014. Until that time, most of the restaurant are still reporting sales manually and BK has only incomplete data on sales.

Computer Security

Given its worldwide status, Burger King wanted to use automation to help it efficiently assign and manage the identities and network privileges tied to enterprise and online initiatives. "In our opinion it is a necessity," says Burger King's chief information officer, Rafael Sanchez. Such tools are needed "because every organization has legacy systems, and most legacy systems have their own security." (Liddle October 2003) In 2003, the installation of Oblix NetPoint software for enterprise Web access and identity management purposes was the latest development in a sweeping Burger King information technology project. That undertaking, for which Burger King involved consultant PricewaterhouseCoopers, is aimed at improving internal network security and controls over financial statements and enhancing the chain's performance by better empowering employees and improving relationships with franchisees, and vendors.

According to Burger King officials and PricewaterhouseCoopers documents, the latter two goals can be achieved by making available to field personnel, franchisees and suppliers certain business support applications and information once accessible only by select headquarters or regional staff. Such information sharing can take place through an Internet portal that might also benefit Miami-based Burger King by acquiring additional higher-quality operations information from franchisees, a PricewaterhouseCoopers case study of the project suggested.

Oblix NetPoint supports "single sign-on" for network users, or the consolidation of user-ID and password information for multiple Web-based applications or applications with Web front ends. It works with the Active Directory feature of Microsoft's Windows Server to streamline and automate several of the steps needed to make changes to user identity information and access privileges. The NetPoint software supports self-registration by users and the delegation of some administrative duties to certain classes of end users, such as department heads. It also ties access and privileges administration into a user organization's workflow routine. That makes possible scenarios such as one in which network access is immediately revoked for any employee subject to a termination notice from the company's human resources department.

Under the former security plan at Burger King, different legacy applications required or permitted administrators to create log-in IDs of passwords different from those used for other programs. That, CIO Sanchez says, made it possible for individual users to wind up with multiple log-on IDs or passwords or both. In the Burger King information technology realm "a person may have access to from five to 15 different applications," Sanchez explains. Those programs, he adds, include such things as basic network access and applications tied to sales, finance, and franchise-related matters.

Sanchez says he or someone else in his department had to change log-on IDs and password information and access privileges for a variety of applications whenever an employee joined the company, left the company, was given additional responsibilities, or was stripped of duties. Because disgruntled terminated employees are a potential threat to company resources accessible via a network, Sanchez says of the old security plan, "I had to pray that whoever provided access [to the employee in question] let me know about the termination." Creating an identity management infrastructure "allows you to manage the [network] environment a lot more efficiently," Sanchez says. "Everyone has one user ID and password for everything they use."

According to Sanchez, under the new system the "primary user of a particular application," such as a department head, assigns access and privileges to people within his or her sphere of influence. Such assignments, however, must be in keeping with the protocols and security parameters established by the configuration of NetPoint and the underlying identity management infrastructure, he indicates. "Dealing with outside communities—that is where we will use the power of Oblix [NetPoint] for self-administration," Sanchez remarks, referring to resources he expects to save by delegating administration of identity and privileges to suppliers and franchise groups with extranet access. The concept, he says, is that he might say to a supplier, "I'll give you access for up to 20 people, but the internal assignment within your company is your responsibility."

Human resources "can clue us [to personnel changes] in house, but when your partners are outside, it becomes even more difficult" to determine who should have access or who should have access terminated, Sanchez observes. Burger King's goal, Sanchez reports, is to reduce the time spent administering network security, while increasing the company's ability to implement new security strategies. To help achieve that goal, the Miami-based chain used PricewaterhouseCoopers to help build a modern directory and identity management infrastructure.

Among other things, Burger King will use its new identity management capabilities to help support portal access to the company's SAP R/3 suite of applications. Offering a wide range of end users access to business support software through a portal with solid identity management underpinnings "allows us to extend the applications to the outer edge" of the Burger King universe, Sanchez says. "Technologies like identity management that drive costs down and increase employee, franchisee and [business] partner satisfaction give companies in the restaurant industry a competitive edge," Sanchez states. Because the use of NetPoint will reduce to one the number of log-on IDs and passwords used by Burger King employees, it should be easier for those workers to remember that information. And that, Sanchez says, should help reduce costs, or at least the workload, associated with the chain's information technology help desk.

The Internet

Burger King sometimes runs off-beat advertising campaigns. In 2009, they created a new campaign that involved Facebook. The company offered people free hamburgers if they deleted 10 online friends, calling it the Whopper Sacrifice. Facebook took offense at the campaign—partly because the BK site sent messages to the people being deleted telling them they were sacrificed for a free burger (Gaudin 2009). About 60,000 people had taken advantage of the free burgers in the first week, but BK decided to stop the campaign after discussions with Facebook.

Questions

1. Why is security so important to Burger King?
2. Why is technology standardization so critical?
3. Do all franchises need to worry as much about security, or just the fast-food industry?

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Case: Wendy's

Driven by expansion and new product offerings, U.S. annual sales gains at Wendy's (ticker: WEN) Old Fashioned Hamburgers outpaced those of McDonald's from 1998 through the end of 2002. According to *Nation's Restaurant News,* Wendy's market share in the quick-service sandwich sector rose to 11.4 percent in 2002, from 10.3 percent in 2000. While the company's expansion enabled it to continue capturing market share in 2003, same-store sales at its restaurants were down, year to year, through July. This decline was due to a change in comparisons from 2002 and competitive pressures, particularly from a recovering McDonald's. Systemwide sales for 2006 totaled $7.8 billion. Same-store sales increased by less than one percent, but profit margins at company-operated restaurants increased slightly.

The company has sustained its image as selling high-quality products in the quick-service sector and continues to enhance its reputation for offering a diverse selection of sandwiches. The company has also maintained industry-leading customer satisfaction scores. Future plans include an increase in national advertising spending targeting the growing number of Hispanics and late-night customers. Though the company has stalled for the near term, its strong brand image has prepared it for the longer term. In 2006, the company spun off the Tim Hortons and Baja Fresh subsidiaries, and approved the sale of its Café Express stores. Apparently copying McDonald's, the company used the funds to repurchase more than $1 billion in shares, hoping to prop up the stock price. According to Wendy's annual report, the company intends to expand its breakfast offerings to more store in an attempt to grow revenues in this newer segment. The company recognizes that it needs to work to rebuild its image. It also needs to reduce expenses, partly through selling some of the company-owned stores. In 2007, Wendy's executives floated the news that it was willing to be purchased—possibly by a private equity firm.

In 2011, Wendy's sold off the Arby's chain for $130 million to a private equity firm. The Arby's chain had suffered during the 2008 recession—largely because its sandwiches are more expensive than those at other chains. Wendy's will initially retain an 18.5 percent share of the new company.

Customer Cards

Under the direction of Scott McClenahan, Wendy's in Redwood City, Utah, is collaborating with Visa USA in a payment card acceptance pilot test. Wendy's is using a Verifone Omni 3200 customer-activated, credit-card-payment terminal on the front counter and a Verifone Everest terminal at the menu board in the drive-through. In configuring the Everest for the drive-through, Verifone developed a weatherized case for the terminal and attached a MagTek dual-head "dip" card reader to minimize instances of incorrect insertion that could slow transactions. The drive-through Everest terminal served as a remote link to the countertop Omni model. The two units were connected by a cable that ran underground from the restaurant to the outdoor terminal at vehicle-window height near a red LED order-confirmation board.

To keep transaction times as low as possible, most quick-service chains have limited their initial tests of card acceptance to credit cards and "check cards" that can be processed without requiring card users to sign receipts or enter personal identification numbers. As a result, drive-through point-of-order payment terminals often came without numeric keypads. The latest card-acceptance platforms combine a payment terminal supporting PIN-based debit transactions with LCD order-confirmation systems. A 2.4-gigahertz, wireless transmitter with encryption capabilities from AeroComm is now being used to transfer payment terminal data to the POS system.

Drive Through

Drive-through orders add up to 75 percent of a fast-food restaurant's sales. But most restaurants have only one order-taking station and that slows down the process. You have undoubtedly sat in the lines waiting for the person in front of you to stumble through an order. Miami Management, Inc., a company that owns 16 Wendy's franchises places two order stations in the drive-through lane. All of them are connected to an order center in Lexington, KY through voice-over-Internet technology. The orders are entered into the point of sale system and displayed at the appropriate restaurant. Brian Fields, director of operations noted the system increased peak lunch hour performance from 117 to 137 cars per hour (Mitchell 2006). But all was not perfect. In at least one restaurant, the manager reported that the call center employees sometimes got orders wrong or failed to greet customers (Mitchell 2007). Part of the problem was that restaurants chose to use lower-priced DSL phone lines instead of dedicated T1 connections. And in many locations, the communication quality was inconsistent or poor.

Questions

1. Why has Wendy's been more successful at identifying customer desires than Burger King?
2. How do most customers pay for fast food? How much are they willing to pay in service charges to use ATMs in the restaurant?

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Case: Yum! Brands

After several years of closing unprofitable stores and selling company-owned units to franchisees, Yum! Brands Inc. (ticker: YUM) has shown renewed vigor. The owner of the KFC, Pizza Hut, and Taco Bell brands acquired the Long John Silver's and A&W restaurant brands in 2002 as part of its multibranding restaurant strategy. The company is aggressively expanding internationally as well, particularly in China, Mexico, Korea, and the United Kingdom. The company's diversified portfolio has enabled Yum! Brands to successfully grow its business despite difficulties that may occur at any one of its restaurant brands. Through late August 2003, strength at Taco Bell had helped to offset difficulties at KFC, while overall profitability was aided by a weaker dollar. Today, Yum! Brands, with 33,000 restaurants in five major chains and 2006 revenue of $9.6 billion with worldwide total system sales of $31.1 billion, is the world's largest restaurant operator in terms of units (34,595 in 2006). Yum has focused heavily on international growth, including KFC in China. The potential sales to over 1 billion customers is appealing to any company, but KFC has had to weather challenges with supply—particularly with SARS, the avian virus. According to the company's 2006 Annual Report, Pizza Hut is already the leader in casual dining in the UK and KFC and Pizza Hut are the number 1 quick-service brands in mainland China. In 2011, Yum! announced that it was selling the A&W and Long John Silvers chains. The company also announced plans to expand in China by acquiring the Little Sheep chain. Yum already owned 20 percent of the company, and profits from China were driving profitability for the entire company in 2010 (annual report).

The restaurants are trying to lift traffic and sales around the world by adding ambience, quality, and service to a business that largely ignores such niceties. Emphasis is placed upon training at the counter and upgrading the restaurants in terms of equipment and food. The average checks in the restaurants are $3 to $4 at Taco Bell and $5 to $7 at KFC.

While the burger chains duke it out on price, KFC, Pizza Hut, and Taco Bell are adding and emphasizing better food, which, in the case of KFC's roasted chicken, at least, also means lighter fare. Yum restaurants are pushing higher-priced items to bolster dine-in business. Among them: Pizza Hut's Chicago Dish pizza ($13) and Taco Bell's popular Southwest Steak Border Bowl ($3.50).

The CEO, David Novak, began an overhaul in 2000 in response to customer feedback. Customers bluntly told the chains their service was shoddy, their food subpar, and their restaurants, in some cases, shabby (Wells 2003). Novak, aged 50, still fumes when he recalls answering a call on Taco Bell's toll-free complaint line in early 2001. A woman named Michelle complained bitterly about getting the wrong $3.60 order and a lot of attitude. “I can assure you Michelle would be justified to tell everyone she sees about how poorly she was treated,” Novak exploded in an e-mail to restaurant managers after the call. “This is the kind of word-of-mouth that kills us.”

David Novak hopes that acting on this feedback will make the company stronger. Employees at all the chains around the world now attend training four times a year at which customer-service initiatives are hammered home. They also get evaluated, in part, on how they treat customers and react to problems when they arise. Novak is pushing to slice service times, particularly at Taco Bell and KFC. At Taco Bell a timer installed at drive-through windows beeps after 60 seconds. This is the time in which an employee is supposed to spend taking and filling an order. Novak blames some of the lingering problems at the restaurants on former owner PepsiCo. He feels Pepsi emphasized marketing at the expense of quality food, service, and atmosphere. “It wasn't our schtick,” PepsiCo President and Chief Financial Officer Indra Nooyi answers. “The restaurant business wasn't our schtick.”

David Novak is orchestrating this dramatic shift to civilize the fast-food experience. At Taco Bell, where food is delivered to its 6,444 U.S. restaurants premade, new $1,450 grills are being installed to cook new menu entries on-site. Restaurants in the Mexican-themed chain are also paying $16 million more a year for better-quality beef, tortillas, and beans. The company is developing higher-end ideas, such as Yan Can, the name of four new Asian-themed restaurants in California created with Arthur Ho, a Hong Kong-based franchisee of KFC, and chef Martin Yan of PBS Yan Can Cook fame. Average sales at these restaurants exceed $35,000 a week, compared with just under $20,000 a week at a typical Taco Bell. Yum! Brands is also combining Pizza Hut with a fast-casual chain called Pasta Bravo in test markets.

Some Taco Bell franchisees argued against paying more for the new ingredients. “I didn't think our customer base was that discerning,” says Ned Kirby, a franchisee in Noblesville, Indiana “But they noticed the better food and didn't resist the higher prices” (Wells 2003). Not every trial restaurant is successful. Bell Grille was an experimental restaurant the company opened in Garden Grove, California to test higher-end menu items, such as smoothies. According to Emil Brolick, president of Taco Bell, it was short-lived, because the food did not fit in with the restaurant, which looked like a regular Taco Bell.

Novak is also pushing to pair the different Yum! Brands restaurants in multi-branded units, which offer unit sales that are 20 percent higher than that of stand-alone restaurants. With just 1,870 twofers open, the goal is to have 6,000 by 2007. Novak has focused on new designs for the multibranded units, emphasizing what traditionally makes fast-casual chains popular. The new designs include inviting lighting with sleek sconces that are conducive to reading or hanging out. Whimsical murals fuse the personalities of two restaurants when they are combined into one unit. "Fast-casual chains make a statement. They spend little on advertising but a lot on the dining experience. If we apply this kind of thinking to our category we think it will give us some edge" (Wells 2003).

Given the weakness in the market sector and the focus on fast-food companies' vulnerability to new lawsuits, Yum's stock has recently fallen. Since 1997, revenue has sagged from a high of $9.7 billion. Since that time, operating income has more than tripled to $891 million in 2001. Debt has been slashed from $4.6 to $2.1 billion. Emphasis continues to be placed on refurbishing the restaurants themselves in a concentrated program.

Yum has experienced problems with its supply chain, from SARS in China to E. coli in lettuce in New England in December 2006, costing the company at least $20 million in profit (Annual Report). Sales growth in the U.S. was flat in 2006, but 4 percent worldwide. Almost all of the growth was through new stores. Pizza Hut has to compete against all of the fast food chains, the national pizza chains, and the local pizzeria. Domino's CEO David Brandon said that "our industry has seen a shift where all of the national brands have lost market share and seen significant reductions in traffic growth at the expense of regional and local pizza shops" (Gibson 2007). Papa John's CEO also notes the lack of product innovation. On the other hand, Papa John's is promoting online ordering in an attempt to build brand loyalty.

In 2005, Alinean, a research company, awarded Yum! Brands the number 3 spot in the retail industry in terms of return on IT investment. Dividing economic value added by its IT spending gave it a value of 201 percent, not to far below the 290 percent of the number 1 company (Next Group PLC) (Betts 2005).

One of the challenges of Yum! Brands is that the company actually consists of multiple "concept" restaurants. Finding common ground and getting 1.6 million global employees to work together is a challenge. In 2011, Dickie Oliver, head of global IT at Yum! Brands emphasized a four-point strategy for coordinating workers. He created the iChing social network to enable employees to post documents, ask questions, and collaborate. Similarly, an enterprise search system from Coveo enables workers to search for answers and data. An online learning system from Saba makes it easier to distribute training. And a high-definition videoconferencing system from Tandberg lets employees hold virtual meetings to reduce travel time and costs.

Questions

1. How does Yum! Brands use information technology to improve efficiency?
2. With the mix of restaurants, how could Yum! Brands use IT to determine the best store combinations and selection of items to sell?

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Case: Starbucks

Since 1985, Starbucks (ticker: SBUX) is committed to offering the highest quality coffee and the Starbucks Experience while conducting its business in ways that produce social, environmental, and economic benefits for the communities in which it does business. In addition to its retail operations, the company produces and sells bottled Frappuccino coffee drinks, Starbucks DoubleShot coffee drink, and a line of super-premium ice creams through its joint venture partnerships. The company's brand portfolio provides a wide variety of consumer products. Tazo Tea's line of innovative premium teas and Hear Music's exceptional compact discs enhance the Starbucks Experience through best-of-class products. The Seattle's Best Coffee and Torrefazione Italia Coffee brands enable Starbucks to appeal to a broader consumer base by offering an alternative variety of coffee flavors. Some of these products are now sold directly to consumers as Starbucks VIA Ready Brew and through national food distributors SYSCO Corporation and US Foodservice.

An interesting feature of Starbucks is that it does not franchise its stores. Starbucks has grown to 8,833 corporate stores plus 8,025 licensed retail stores internationally in 2010 from only 125 stores in September 1991. Starbucks purchases green coffee beans for more than 50 blends and varieties from coffee-producing regions worldwide. All green coffee beans purchased are of the Arabica species, which is of higher quality than the Robusta species typically found in supermarket coffees. Starbucks custom roasts the coffee beans to exacting standards. To add sales margins, the company stores offer a wide selection of coffee-making equipment, accessories, pastries, and confections.

In fiscal year 2010, retail stores accounted for 84 percent of net sales. Stores are typically clustered in high-traffic, high-visibility locations in each market. This includes office buildings, downtown and suburban retail centers, and kiosks placed in building lobbies, airport terminals, and supermarkets. In fiscal year 2002 the retail store sales mix by product type was 77 percent beverages, 13 percent food items, 6 percent whole bean coffees, and 4 percent coffee-related hardware items.

Starbucks has expanded its retail business by increasing its share in existing markets, and opening stores in new markets in which it sees an opportunity to become the leading specialty coffee retailer. The company opened a net total of 810 company-owned stores in fiscal year 2006 and planned to open a similar number in fiscal year 2007. But in the U.S. it closed 474 stores in 2009 and 57 in 2010. Starbucks has tried to use its Specialty Operations, which accounted for 16 percent of total revenues in fiscal year 2003, to develop the Starbucks brand outside the company-owned retail store environment. Starbucks has licensing agreements

(35 percent of specialty revenues) with prominent retailers in North America, Central America, Europe and Asia. The company has about 5,600 food service accounts (27 percent), where it sells whole bean and ground coffee to various coffee distributors, hotels, airlines, and restaurants. Starbucks has a licensing agreement (13 percent) with Kraft, Inc., which markets and distributes the company's whole bean and ground coffees in the U.S. grocery channel. In addition, the company sells its coffee products through warehouse club accounts (13 percent), and through mail order and online (7 percent) (Standard and Poor's, Starbucks annual report). The company's long-term plans are to run 20,000 stores in the U.S. and another 20,000 worldwide, with an emphasis on China. Although the Annual Report observes the increasing difficulties in managing that many stores, comparable store sales grew by 7 percent in 2006; but hints are that the growth rate has slowed in 2007. The company also spent $1 billion buying back its stock to prop up the price (Blumenthal 2007). From 2007 through 2009, Starbucks was hit hard by the recession where sales growth slowed and fell in 2008 and 2009 (annual report 2010). Howard Schulz returned to the CEO position in 2008 to help organize the response to competition and the recession.

In the fourth quarter 2003, Starbucks acquired Seattle Coffee Company, which includes Seattle's Best Coffee and Torrefazione Italia coffee brands, for $72 million. Negotiating and controlling the supply of its products is a key factor in the Starbucks operation. The company also spent $6.5 million in 2006 on research to create and improve products as well as operations (Annual Report).

When the top management was replaced in 2008, Starbucks also named Chris Bruzzo to be acting CIO and asked him "to create innovative ways for Starbucks to connect with our customers and build loyalty programs" (Wailgum 2008). At the time, the company had grown too rapidly—unfortunately just as the economy was entering the recession. The firm was focused on growth through adding new stores, so the technology focused on evaluating real estate, location, and demographics. Instead, the company needed to find a way to encourage each customer to spend more money.

In 2009, Stephen Gillett was given the job of CIO at Starbucks. He has an IT staff of 1,000 people. The size of the staff is almost a problem—it is difficult to find and hire good workers. And he still faces one key area: business intelligence—finding people and tools that can analyze the customer data (Mann 2009).

Stored Value Card

Brian Cyrnes, senior vice president and chief information officer, is proud of the coffeehouse chain's stored-value, customer loyalty-enhancing Starbucks Card and Duetto. The new Duetto offering is a combination Starbucks Card and Visa credit card. This was accomplished by keeping an eye toward offering the best service and value, while targeting competitive advantages, speed-to-market issues, and enterprisewide integration. The launch follows the success of the reloadable Starbucks Card, of which more than 11 million have been activated since the card began in November 2001. A Starbucks Visa credit card, incorporating the stored-value feature, was launched in association with Bank One in March 2003.

The Starbucks Card program was run by an outside vendor, ValueLink, a First Data Corporation. First Data is an electronic payment service specialist. Customers buy the cards in dollar amounts to be redeemed like cash at the checkout line. ValueLink processes the transactions and manages an offsite database for the system. The program is already "a big loyalty winner." Starbucks redeemed 11 million cards worth $41 million in the recent second quarter. Starbucks outsourced the processing because it felt it lacked the knowledge to develop a complex customer service program on its own.

Wi-Fi technology

Based on its experience at thousands of Starbucks Coffee outlets, Starbucks is convinced that providing Internet access to guests will build customer loyalty and sales. As a result, Starbucks is forging ahead with deployment of wireless local area networks, as other food service chains accelerate rollouts or expand tests of the technology. Starbucks Corp. launched Wi-Fi service in its U.S. cafes in August 2003 and now offers access in over 2,000 locations. Users have to sign up for the service with Bellevue, Washington-based T-Mobile USA Inc., a unit of Deutsche Telkom, whose prices start at $19.99 per month. The T-Mobile HotSpot service is backed by reliable high-speed T-1 connections that can accommodate the full spectrum of applications from checking e-mail to viewing rich multimedia and video. T-Mobile HotSpot window signs are visible near the entrance of all participating Starbucks locations. A complete list of stores can be found by visiting the Starbucks store locator on www.starbucks.com/hotspot and selecting "Wireless HotSpot Stores" as the Store Type.

Today the chain has fee-based hot spots managed by strategic partner T-Mobile International at about 2,600 of its 3,854 company-operated coffee bars. The goal is to install hot spots in about 70 percent of the retail sites operated by the company. Size, seating capacity, and the demographics of a market all determine which stores will incorporate the technology. Starbucks looked at a number of alternatives in terms of how to provide in-store Internet access, but decided wireless was the way to go to provide access without disrupting the other customers. The chain did not want to become known as an "Internet café" littered with cabling and other hardwired network paraphernalia.

The wireless service is already paying dividends at Starbucks. The company charges customers about $6 an hour for the T-Mobile service. The typical wireless user stays for 45 minutes. Of the nonwireless users, 70 percent spend 5 minutes or less at the store; the remaining 30 percent linger for about 20 minutes. "We certainly believe that means they buy more coffee and food. The real exciting thing for us about the hot-spot service is that it is bringing people into our stores at different times of the day, and hot-spot users are staying longer," Nick Davis, Starbucks spokesman, remarked. (Liddle August 2003). Typically, a Starbucks unit is busiest from 6 a.m. to 9 a.m., so building traffic later is a positive development. About 90 percent of hot spot users arrive after 9 a.m., and that group, on average, spends about 45 minutes online and in the stores.

In the attempt to leverage its wireless network installations further, Starbucks in 2004 began testing possible synergies between its hot spot strategy and the distribution of product by its music industry holding, Hear Music. To spur additional hot spot registrations and publicize Hear Music's "Artist's Choice" compact disc of Sheryl Crow's favorite songs by other recording stars, Starbucks' hot spot users were given Web access to audio clips of the songs and Crow interviews on the CD. They were permitted to download three complete songs from the compilation product.

By 2010, partly pressured by McDonald's, Starbucks opened the Wi-Fi to free and unlimited access. Other coffee shops find Wi-Fi to me more challenging.

Freeloaders might buy a cheap cup of coffee and then take up space for hours—making it hard for paying customers to find a place to sit (Elgan 2010). Starbucks will also offer free access to major newspapers such as *The Wall Street Journal* and *New York Times*.

Starbucks and the Sundance Film Festival

In addition to being the official coffee at the 2004 Sundance Film Festival, Starbucks worked closely with the Sundance Institute to sponsor the 2004 festival, as well as bring the excitement of the Sundance Film Festival experience directly to customers in its stores. Throughout the month of January, customers who visited their favorite participating Starbucks location with a Wi-Fi (802.11b)-enabled notebook computer or Tablet PC experienced the passion and inspiration of the 2004 Sundance Film Festival firsthand. By simply launching the Internet browser on their device, customers watched exclusive filmmaker interviews, behind-the-scenes video clips, and film trailers for free prior to logging on to the T-Mobile HotSpot wireless broadband Internet service.

Customers who logged on to the T-Mobile HotSpot service received a free day pass to the Sundance Online Film Festival—the online extension of the 2004 Sundance Film Festival. The free day pass enabled Starbucks customers to access the Sundance Online Film Festival, where they could cast a vote for their favorite animation and short subject films while in the comfort of any participating Starbucks location. Independent film aficionados and consumers did not have to be in Park City to experience the festival—they only needed to find the nearest T-Mobile HotSpot-enabled Starbucks to access the exclusive content.

Starbuck's sponsorship of the film festival enabled them to add value to the T-Mobile HotSpot service in their stores by giving their customers the ability to interact directly with digital entertainment. Since Starbucks has sponsored film festivals large and small, this next step enabled the company to share their enthusiasm for independent film directly with their customers. Starbucks expanded its involvement in the entertainment industry—even creating a separate subsidiary. In 2006, it promoted a movie to its customers, but the effect was minimal. In 2007, Starbucks continued its sales of music CDs with a special solo album from Paul McCartney. Starbucks also backed another movie in 2007 (Adamy 2007). Analysts are mixed over whether the entertainment options attract customers and encourage sales, or if they just distract management from selling coffee.

Phones

Like many other companies, Starbucks sells customers a prepaid card that can be used for future purchases. In 2011, Starbucks released an app that lets customers store their prepaid card data on their smart phone. Cashiers simply scan the bar code from the phone and deduct the amount from the balance (Segall 2011). Because the Starbucks card is linked to a credit card, the payment card can be reloaded. The smartphone app includes the ability to easily add more money to the card (Hamblen 2011).

In a different twist, Starbucks in 2010 became one of the first companies to pay Twitter to deliver "Promoted Tweets," or advertising over Twitter. The marketers will be charged per thousand impressions of their ads that are displayed on their Web site alongside search results. Starbucks already publishes Twitter notes about its promotions, but the ads will always show up near the top of the page, making them more visible (Miller 2010).

Questions

1. Has Wi-Fi access improved sales and profits at Starbucks?
2. Given the huge number of stores, how could Starbucks use information technology to determine where to open new stores and which ones to close?

Additional Reading

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Miller, Claire Cain, "Twitter Unveils Plans to Draw Money from Ads," *The New York Times*, April 12, 2010.

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Part 1

Information Technology Infrastructure

What are the main features and tools of information systems?

How is information technology changing and how do you evaluate and choose technologies for business? How do you share information and collaborate? How do you store and retrieve data?

These are fundamental questions that any manager needs to be able to answer. Information technology forms the foundations of management information systems. As a manager, you need to understand what technologies are available today, and how they are likely to change tomorrow. Although you do not have to be able to build your own computer, you need to understand the trends and limitations of computing equipment.

Networks are critical in most organizations today. The Internet continues to expand into professional and personal lives. Managers should understand how wired and wireless technologies can be used to share data and communicate. Particularly in terms of the Internet, you need to be able to evaluate emerging technologies and evaluate costs.

Database management systems are probably the most important tools in business today. Managers can no longer rely on programmers to answer business questions. Instead, you need to know how to retrieve data and build reports from central databases.

Chapter 2

Information Technology Foundations

Chapter Outline

What You Will Learn in This Chapter

- What types of computers are needed for business applications?
- What are the basic objects that computers process?
- How do computers handle music and video?
- What are the main components of a computer?
- Why is the operating system so important?
- How does the Internet change the role of computers?
- What are the main software applications used in business?
- Is it possible to handle all computing tasks with online services?

Dell

Should you buy new computers? How is information technology changing and how do you evaluate and choose technologies for business? These are difficult questions to answer for any business. Buying one new computer is not the problem—replacing hundreds or thousands of computers is expensive. One of the keys to changing technology is that buying a computer is not a one-time event. Organizations need to plan on buying new machines on a regular basis. Of course, you also have to think about how to dispose of the old computers.

The computer industry is driven by change and growth. An interesting feature of computers is that they have a short shelf life. A computer that sits unsold for a few weeks quickly becomes obsolete as more powerful or cheaper machines are introduced. From a manufacturer's perspective, this pattern of change is difficult to handle. It is even harder when you realize that people often want to try out a computer first. At one time, Dell tried to sell computers through retail stores, but had to give up. Dell's solution has become a driving force in the industry. Dell tightly manages the supply chain and builds each machine to order. Components such as disk drives, processors, and cases are purchased in bulk—often with long-term contracts. The majority of the components are delivered in small just-in-time batches to manufacturing facilities. The individualized machines are built and formatted for each specific customer. Dell holds costs down by minimizing inventory and producing the exact products ordered by customers. Dell risks losing sales to retail stores, but the company knows it will make a profit on every machine.

Which options should you choose on a computer? Do you need the fastest processor, a huge amount of RAM, and a monster disk drive? Where can you cut performance slightly and save money? These questions are hard enough for buyers to answer, but cause headaches for vendors. Again, Dell's made-to-order process reduces the risks. But vendors like Hewlett-Packard, Lenovo, and Acer have shown that with accurate predictions, it is possible to capture a substantial slice of the retail market. The key is to have the combination of features that are demanded by customers, at the right price.

Getting rid of old computer equipment could involve almost as big a decision as purchasing a new computer. California and Massachusetts have banned computer equipment from landfills. Europe and Japan have relatively strict recycling laws. Vendors are struggling to create recycling programs. Dell has committed to increasing the recycling rates by offering new programs that embed the cost of recycling into the new equipment. Other vendors will take back old equipment for a fee of $30 to $50.

Introduction

What types of computers are needed for business applications? Figure 2.1 shows the challenge of the choices. A wide range is available from portable devices like cell phones and tablets to large-screen desktops to enterprise servers and super computers. The interesting aspect is that at each level, the performance and capabilities have continued to improve. So today's desktops have the power of super computers from a few years ago. You are probably familiar

Trends

The first computers were simple pieces of hardware. Like all computers, they had to be programmed to produce results. Programming these machines was a time-consuming task, because all of the pieces were connected by individual wires. Programming the computer consisted of rearranging the wires to change the way the pieces were connected. As computer hardware improved, it became possible to program the processor without having to change the internal wiring. These new programs were just a list of numbers and short words that were input to the machine. These lists of commands were called *software*, because they were easier to change.

Programmers soon learned that some tasks needed to be performed for most programs. For example, almost every program needs to send data to a printer or retrieve information stored on a disk drive. It would be a waste of time if every programmer or user had to write a special program to talk to the printer. By writing these common routines only once, the other programmers could concentrate on their specific applications. As a result, every computer has a basic collection of software programs called an *operating system*. The operating system handles jobs that are common to all users and programmers. It is responsible for controlling the hardware devices, such as displays, disk drives, and printers.

The Internet changed everything by focusing on networks and sharing data. The Web changed everything by making the browser the most important display device. Increasingly, software and data are stored on Web servers. Users rely on browsers installed on a variety of clients—from desktops to handheld computers, tablets, and cell phones.

Hardware trends have been astonishing compared to older industries. Performance, size, and price have continued to improve each year. These changes have created new, portable products and pushed advanced computing into everyday products.

with common user devices such as laptops, cellphones, and tablets. These devices are also important in business, but today they are essentially commodity items that are purchased in bulk and replaced every couple of years. Servers require more attention because they are more expensive and handle important tasks for the entire company.

Some basic aspects of computing hardware have remained the same for many years. However, the continued improvements have led to powerful changes in capabilities and physical size. Small, portable devices now have huge processing and communication capabilities. These changes are leading to new applications, new ways to build information systems, and new ways to interact with computers. Some of these effects are explored throughout this book. In terms of hardware choices, the main impact in this chapter is the question of whether hardware selection matters anymore. For example, most people in the U.S. essentially lease their cell phones paying a small up-front price and paying for the device with higher monthly contract prices. Consequently, it is relatively painless to replace the equipment every two years. As more applications move to cell phones and browsers, the choice of hardware becomes less important every year. Still, it will be a few years before all hardware reaches this state. So, it is still useful to understand some of the foundations of information technology hardware and software.

Figure 2.1

Information technology changes constantly. Change makes it difficult to choose products and control costs as you upgrade over time. As a manager, you have to evaluate the technology features and choose options that provide the functions you need while minimizing costs.

Keep in mind that the demands for data storage and computational tasks continue to increase. So someone has to buy more computing power and data storage on a continuing basis. Most businesses purchase information technology at multiple levels: devices for users, servers for business tasks and data storage, long-run backup, and sometimes intensive analytical tasks. Each of these categories requires different types of computers, and it means someone has to monitor the investments and changes to technology.

Why do you care how computers work? After all, it is easy to use a photocopy machine without understanding how it works. Automobiles cost more than most computers, yet you can buy an automobile without knowing the difference between a manifold and a muffler. You can also make telephone calls without understanding fiber optic cables and digital transmissions.

On the other hand, when you buy an automobile you need to decide if you want options such as power windows, a turbo charger, or a sunroof. Almost every product you purchase has a set of technical elements, and you can find an expert (techie) who is more concerned about details than others. But, does it truly matter to you? Perhaps not, but if you do not understand the options, you might not end up with the car, telephone service, photocopier, or computer that you need. Or you could end up paying extra money for services that you will not use. To choose among the various options, you need to know a little about how computers work.

Computers are typically discussed in terms of two important classifications: hardware and software. **Hardware** consists of physical items; **software** is the logical component such as a set of instructions. Of course, many functions can

Single bit: one or zero (on or off)
8 bits = 1 Byte: 10101010
1 Byte holds values from 0 - 255

$2^0 = 1$	$2^6 = 64$
$2^1 = 2$	$2^7 = 128$
$2^2 = 4$	$2^8 = 256$
$2^3 = 8$	$2^9 = 512$
$2^4 = 16$	$2^{10} = 1024$
$2^5 = 32$	$2^{20} = 1,048,576$

Bytes	bits	Power of 2
1	8	256
2	16	65,536
3	24	16,777,216
4	32	4,294,967,296
8	64	18,446,744,073,709,551,616

Figure 2.2

Byte and bits. Binary counting imposes some limitations based on the size of the counter. Note that 32-bit hardware and software can only address 4 GB of memory. Windows 7/32-bit is limited to 3 GB. To use more RAM, you need 64-bit hardware and software.

be provided in either software or hardware, and a computer user often cannot tell which has been used, and most often does not care. The one main difference is that it is easier to make changes to software than to hardware—especially since software patches can be transmitted across the Internet. Before looking at the various hardware components and software options, it helps to examine the primary data types. You care most about the tasks a computer can perform, and the data types are the fundamental blocks within any information system.

Types of Data

What are the basic objects that computers process? To a computer user, the most important aspect of the computer is the data that it handles. Today, computers are used to process five basic types of data: numbers, text, images, sound, and video. Because of limited speed and storage capacity, early computers could handle only simple text and numbers. Only in the past few years have computers become fast enough and inexpensive enough to handle more complex sound and video data on a regular basis. As computers continue to improve, these new capabilities will alter many aspects of our jobs and society.

Term	Name	Power of 10	Power of 2	IEC term	Binary value
Kilo	Thousand	3	10	Kibi	1,024
Mega	Million	6	20	Mibi	1,048,576
Giga	Billion	9	30	Gibi	1,073,741,824
Tera	Trillion	12	40	Tebi	1,099,511,627,776
Peta	Quadrillion	15	50	Pebi	1,125,899,906,842,624
Exa	Quintillion	18	60	Exbi	1,152,921,504,606,846,976
Zetta	Sextillion	21	70	Zebi	1,180,591,620,717,411,303,424
Yotta	Septillion	24	80	Yobi	1,208,925,819,614,629,174, 706,176

Figure 2.3

Terms and prefixes. The IEC (electrical) has proposed using different names for powers of two instead of decimal. The new versions are sometimes used in Europe and have been adopted as standards. The goal is to reduce confusion.

Object Orientation

One of the most important concepts to understand with computers is that all data are represented as **binary data**. The computer processor can handle only binary data in the form of bits. Each bit can be on or off or mathematically, zero or one. Processors operate on groups of bits at a time. The smallest group of 8 bits is called a **byte**. The industry often refers to the maximum number of bits that a processor can handle. Common machines use 32-bit processors, but the industry is shifting to 64-bit processors. A 64-bit processor can process 8 bytes of data in one operation.

The number of bits (or bytes) determines the size of individual data that can be handled or addressed. Figure 2.2 summarizes some of the values of binary numbers that commonly arise in computing. In particular, note that a 32-bit system has a limitation of about 4 gigabytes (GB). Consequently, a 32-bit Windows operating system can only address 3 gigabytes of RAM. If you want to use more memory, you need to install 64-bit versions of the operating system and other software.

It can be difficult to deal with huge numbers. So instead of trying to write out strings of zeros and commas, people create names for different levels of numbers. Figure 2.3 lists the main prefixes in use today and some that might be reached in a few years. Notice that there are some differences between decimal and binary values because binary is based on 1024 instead of 1000. These differences were minor at small numbers but become larger with higher powers. Consequently, there is some confusion when you see a number expressed as gigabytes or terabytes. For instance, disk drive vendors commonly count storage space in decimal values (because it sounds bigger); but the Windows operating system reports drive space in binary values so a 512 GB drive (in decimal) only contains about 488 gigabytes of space counted in binary. Drive vendors would probably be happier if operating system programmers reported data in decimal counts instead.

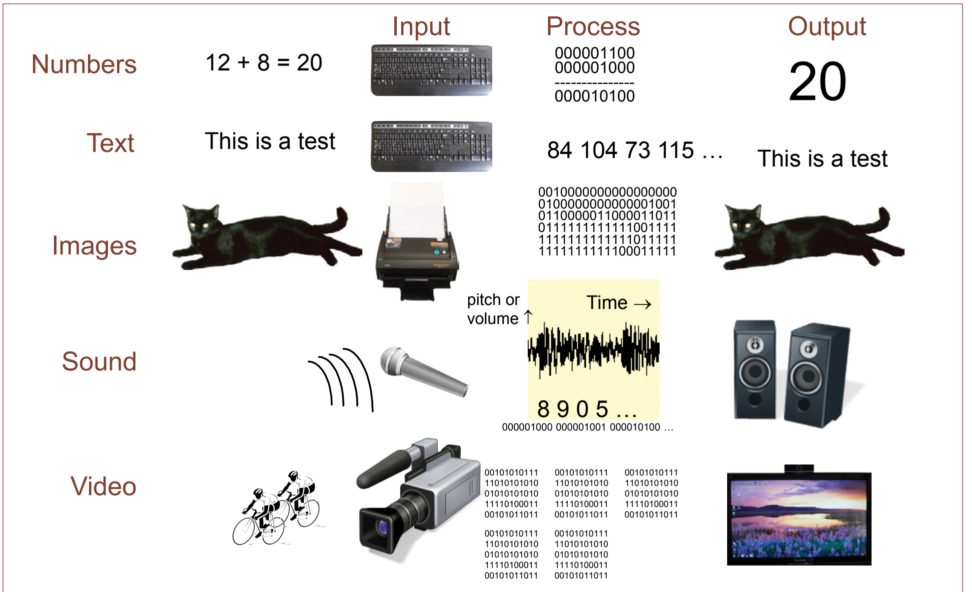


Figure 2.4

Five basic types of data. Because processors only deal with binary data, each format must be converted or digitized. Computer peripheral devices are used to convert the binary data back to the original format.

In common business usage, the prefixes tera and peta are becoming relatively common. Even desktops and laptops can have terabyte-sized drives. Some large companies collect petabytes of raw data, which are a thousand times larger than terabyte systems. A couple of companies have reached the exabyte scale for specialized data. Think about a million terabyte drives for a minute and you will begin to see what happens as companies collect increasing amounts of data.

One of the key points in terms of data storage is that companies avoid deleting data. It can be difficult to know exactly which data might be valuable in the future. Given falling prices for storage, many companies simply decide to keep everything.

Beyond counting, humans do not deal well with bits or bytes. Real-world data consists of analog objects such as numbers, text, images, sound, and video. Figure 2.4 illustrates the five basic data types. Computers need **input** devices to convert these objects into bits. **Output** devices then change this data back to a form that humans can understand. Understanding these types makes it easier to see the industry trends and to understand applications.

Each of the basic data types has its own characteristics. Numbers have a precision and usually a scaling factor. Text has a typeface and display size, as well as appearance attributes such as bold, underline, and italic. Pictures can be described by their resolution and the number of colors. Digitized sound is based on a specified sampling and playback rate, and fits into frequency and amplitude ranges. Video combines the attributes of pictures with a frames-per-second definition.

Along with the attributes, several predefined functions can operate on each data type. Basic functions dealing with numbers include totals, calculations, and comparisons. Standard methods to manipulate text include searching, formatting, and

Reality Bytes: RAM: Smaller, Faster, Less Power

In early 2011, Samsung announced the production of the first DDR4 RAM module. Based on 30 nanometer (nm) lithography the module doubles the access speed from DDR3's 1.6Gbits/sec to 3.2Gbit/sec. Samsung also noted a 40 percent reduction in power consumption when used in notebook computers. At the same time, prices for existing DDR2 and DDR3 RAM was continuing to decline. The market research firm iSuppli noted that in the last six months of 2010, the contract price for 2GB DDR3 dropped from $44.40 to $21. Mike Howard, a principal analyst at iSuppli predicted that DDR3 prices might drop as low as $1 per gigabyte, which would be less than the marginal cost of production.

Adapted from Lucas Mearian, "Samsung Announces First DDR4 DRAM Module," *Computerworld*, January 4, 2011.

spell-checking. Methods dealing with pictures involve artistic alterations such as color or lighting changes, rescaling, and rotation. Existing functions for sound and video are often limited to recording, playback, and compression/decompression.

Most application packages create their own objects as combinations of the basic data types. For example, graphs consist of numbers, text, and pictures. As a result, all of the attributes, and functions that apply to the base types also apply to derived graph objects. Hence, graphing packages can perform calculations on numbers, select fonts for displaying text, and enable you to set colors and rotation for the graph. Other applications, such as slide shows, provide additional functions, like controls for how one slide is replaced by another (e.g., fades, dissolves, and wipes). The point is, once you understand the properties and functions of the basic data types, you can learn how to use any new application by concentrating on the new objects, their attributes and functions. This approach is especially true since many applications are designed and built using object-oriented methods. Increasingly, operating systems are designed around these data types. They have search functions and applications to find and use files that contain specific types of data.

Numbers and Text

Numbers and text are still the most common types of computer data used in business—for example, each cell in a spreadsheet can display a number or text (labels). Most business reports consist of tables of numbers with supporting text.

As shown in Figure 2.5, a key aspect of numbers is that you must be careful with round off—particularly within spreadsheets. Consider the first column of numbers with three decimal digits. What happens when the format command tells a spreadsheet to display those numbers in the third column with only two decimal places? The computer will perform the addition first and round off the displayed result, which means the total will appear to be incorrect. If you really want only two digits of precision, you should use the Round function to convert each number before it is added, as shown in the second column. Precision of calculations is important in business. For example, the 1999 European Union standards require that all monetary conversions be computed to six digits to the right of the decimal point.

Since processors can handle only binary data, how can they deal with text? The answer is that they assign a number to each character in the alphabet, which raises

Precision	ROUND( )	Format
5.563	5.56	5.56
0.354	0.35	0.35
6.864	6.86	6.86
12.781	12.77	12.78

Figure 2.5

Numeric precision. If you tell a spreadsheet to display two decimal-digits, it performs the additions in the full precision of the data—and displays the data in the right column. If you really want two-digit precision, you should use the Round(x, 2) function to roundoff the data before adding—giving the results in the middle column.

a very important, but tricky, question: How many letters are there in the alphabet? The question is tricky because you need to first ask: Which alphabet? Until the 1990s (or later), most computer systems were based on an English-language assumption that there are only 26 letters in the alphabet (plus uppercase letters, numbers, and punctuation). The key to numbering the alphabet is that all hardware and software vendors have to agree to use the same numbering system. It is a little hard for everyone to agree on a system that only displays English characters. Consequently, most computers today support the **Unicode** system. Unicode is an international standard that defines character sets for every modern language and even most dead languages.

Figure 2.6 shows that a key feature of Unicode is that it can handle oriental languages such as Chinese and Japanese that use ideograms instead of characters. The challenge with ideograms is that each language contains tens of thousands of different ideograms. Character-based languages like English used to be handled by storing one character number in one byte. But one byte can only hold 256 (2^8) numbers—which is not enough to handle ideograms. Consequently, Unicode uses two bytes to count each character or ideogram, enabling it to handle 65,536 (2^{16})

Figure 2.6

Character sets. Standards define how alphabets and ideograms are converted to numbers. Early systems were based on the English language and extended to handle Latin-based characters. Today, Unicode is the preferred way to encode text because it can handle any language. However, it takes twice as much space to store Unicode data.

Time	Languages	Character Sets
Early	U.S. and England	ASCII and EBCDIC 127 characters, 7 bits/1 byte
1980s	Latin-based characters: tilde, accent, umlaut, ... ñ, é, ö	Code pages and extended character sets 255 characters, 8 bits/1 byte
1990s	Asian ideograms, plus any language 日本語 中文 Российская	Unicode All modern langauges and most dead languages 1 character, 2 (or 3) bytes

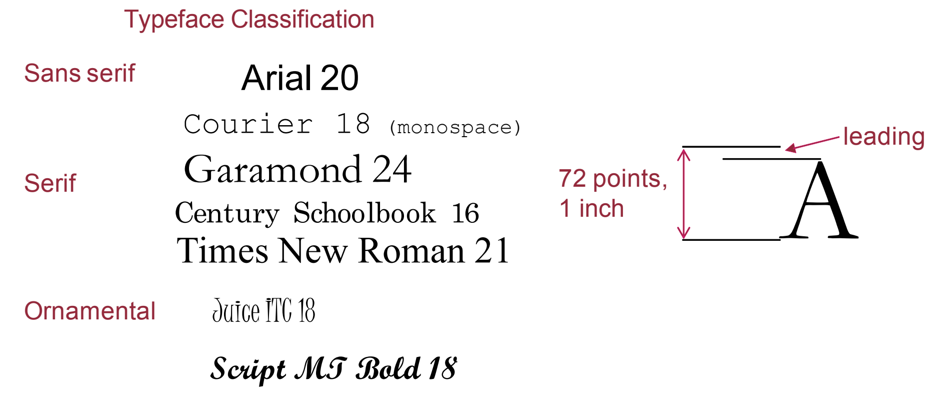


Figure 2.7

Typefaces fall into two main categories: serif and sans serif. Serifs are little curls and dots on the edges of letters. They make text easier to read; however, san serif typefaces are useful for overheads and signs because the added white space makes them easier to see from a distance. Ornamental typefaces can be used for headlines. Size of fonts is measured in points. Characters in a 72-point font are about 1 inch tall, and most books and newspapers use a font between 10 and 12 points.

ideograms in each language. It also has the ability to switch to three bytes if even more characters or ideograms are needed.

Why do you care? Remember the increasing importance of international trade. If you build a computer system or database that needs to be used around the world, make sure that you use the Unicode character set so you can collect data in multiple languages. Unfortunately, some systems by default still use the older character systems, and you have to deliberately change the settings to ensure you can handle other languages.

Figure 2.7 illustrates one of the more important properties of text: its typeface. You can choose from several thousand typefaces to achieve a desired style. Be careful with your choices. Some choices are obvious; for example, do not use an ornamental (script) typeface to write a business report. Also, serif fonts are typically used for printed material, and sans-serif fonts are used for very small or very large presentations. Other choices are more subtle and may require the assistance of a professional designer. You will also have to choose font sizes. The basic rules of thumb are that most printed text is displayed at 10 to 12 points. It is also useful to know that letters in a 72-point font are approximately one inch tall.

Pictures

Pictures, graphics, and icons are used to display graphs and charts. Pictures are sometimes used as backgrounds or as **icons** in presentations that are used to help the audience remember certain points. In fact, almost all of the computer work that you do today is based on a graphical perspective. Video screens and printers are designed to display everything, including text, in a graphical format. The graphical foundation provides considerably more control over the presentation. For example, you can change the appearance of characters or combine figures and graphs in your reports.

Reality Bytes: Print Your Own Parts

Have you ever tried to track down a replacement part for a faucet, a toy, a lawn mower, printer, or some other device? You might be able to track down the manufacturer and order the part. Today, many of the manuals are online so it is feasible, but you still have to wait. What about designing and building new objects? If you are an inventor and have a new product idea, you need a fabrication shop with expensive tools to create prototypes. What if you could build any small-size part you need using a 3D fabricator that essentially prints the part in plastic or metal powders? Manufacturers could put design specifications for replacement parts online, you could download the design, run the "fabber" and have your part built from scratch in a few minutes or a couple of hours. The really cool part? You can build your own fabber for $2400 in parts! The Fab@Home Web site (fabathome.com) has a complete list of parts and directions on how to build the fabber. It also has examples of the projects they have built. The device is computer-controlled and works like a printer but uses syringes to deposit silicon, epoxy, or cake icing in layers—building up the product one layer at a time.

Adapted from Tom Simonite, "Desktop Fabricator May Kick-start Home Revolution," *New Scientist*, January 9, 2007.

Two basic ways to store images are bitmap and vector formats. The easiest to visualize is bitmap (or raster or pixel) format. A **bitmap image** is converted into small dots or **pixels** (picture elements). If the picture is in color, each dot is assigned a (binary) number to represent its color. This method is often used to display photographic pictures where subtle changes in color (such as blends) are important. Bitmap pictures are evaluated in terms of the number of colors and resolution of the picture. **Resolution** is often measured in **dots per inch (dpi)**. You will encounter certain problems with bitmap images. Consider what happens if you create a bitmap picture in a square that has 50 pixels per side. How do you make the image larger? Use larger dots? Then the lines are very rough. How can you stretch the picture into a box that is 100 by 200 pixels? Although these operations are possible, they do not usually produce good results.

Historically, it took several years, and the Web, for companies to standardize on the types of image file formats. Today, although individual software packages still have their own proprietary formats, most of them can save and edit files in the three major formats: GIF, JPEG, and PNG. All three are bitmap formats and have slightly different benefits. The PNG format is newer and combines most of the benefits of the other two formats, so it is a good default choice. However, JPEG (Joint Photographic Experts Group) is still commonly used by most digital cameras.

When you need to change the size of pictures and keep fine lines and smooth edges, it is better to store pictures in vector format. **Vector images** consist of mathematical descriptions instead of dots. In most cases, they take up less storage space than bitmaps. For example, a line is described by a statement such as: "line from (0,0) to (10,10) in yellow." Do not worry: you do not have to be a mathematician to use vector images. Most of the current drawing packages store their work in vector format. Web browsers are beginning to support a new Internet vector

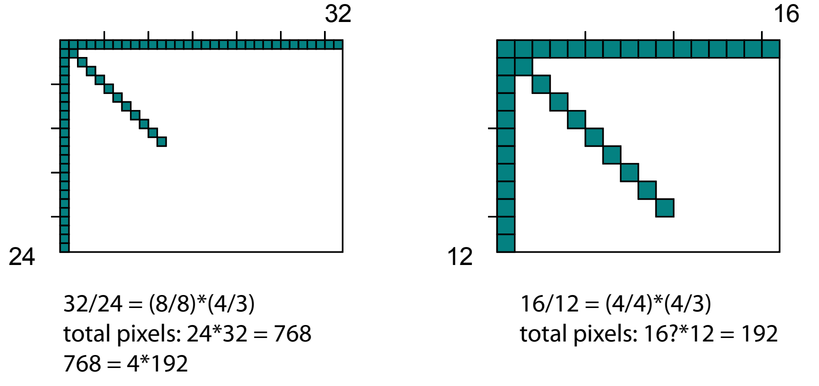


Figure 2.8

Resolution. The image on the left has twice the resolution as the image on the right. In total, the higher resolution image has four times (two squared) the number of pixels, and provides more precise lines—particularly diagonal lines.

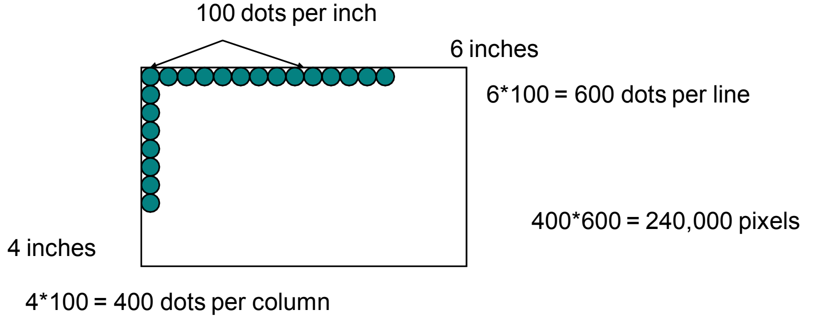
image (SVG: scalable vector graphics) format that provides for faster image transfers and scalable images.

Graphics devices—including displays, printers, digital cameras, and scanners—are evaluated largely in terms of resolution. Resolution is commonly measured by the number of pixels (or dots) per inch. Figure 2.8 shows the importance of resolution. Doubling the number of pixels per inch delivers much finer lines—particularly for diagonal lines. But doubling the resolutions results in four times the number of total pixels—which requires substantially more memory and processing time to handle.

Figure 2.9 shows how to compute the data size of an image. A photo taken with a resolution of 100 dots per inch and a size of 6 x 4 inches has 600*400 or 240,000 pixels. How many bytes are needed to store one pixel? The answer depends on the number of colors. How many colors do you need? The human eye can distin-

Figure 2.9

Resolution and size. Multiple the number of rows by the number of columns to get the total number of pixels. Multiply by the number of color bytes per pixel (usually 3) to get the total raw size (720,000 bytes).



Video			Print			Camera	
Video	**Pixels**		**Method**	**Pixels/Inch**		**Print Size**	**Pixels/Inch**
VGA	640 x 480		Fax	100-200		3" x 4"	768
XGA	1024 x 768		Ink Jet	300-700		4" x 6"	512
SXGA	1280 x 1024		Laser	600-1200		8" x 10"	307
UXGA	1600 x 1200		Typeset	2400		pixels	3072 x 2304
WSXGA	1680 x 1050						
HDTV	1920 x 1080						

Figure 2.10

Resolution examples. Video screens use the 4/3 aspect ratio from the older television standard. HDTV uses a wider 16/9 ratio and about 2.5 times the resolution of the original VGA/TV screen. Final resolution values depend on the physical size of the screen or paper.

guish at most about 16 million colors. Three bytes of storage is 24 bits and 2^{24} is 16,777,216, so many systems use a three-byte color coding. Consequently, the raw data for the image requires 3*240,000 or 720,000 bytes of storage. But, 100 dpi is a weak resolution, 200 dpi would be better for printing. Doubling the resolution results in a total size that is four times larger (2-squared), or slightly under 3 megabytes. A few systems use 32-bit color for a broader color gamut and faster processing.

Most digital cameras express resolution in terms of total pixels instead of dots per inch—largely because the dpi changes depending on the size of the print. Most of the time, you care about the total number of pixels available. More pixels means you get a higher-quality print. Figure 2.10 shows resolutions for some common devices. Notice how the resolution of a photograph declines when it is printed in a larger size. Print resolutions less than 300 pixels per inch (ppi) are grainy and jagged. A similar effect occurs with video screens. On the other hand, almost all operating systems draw text characters with a set font size. Increasing a monitor's resolution results in smaller text. For example, if you have a monitor with a physical diagonal measure of 16 inches, an SVGA resolution produces 80 pixels per inch, so the dot on an 'i' is 1/80 of an inch. Increasing the resolution to UXGA creates 125 ppi, so every character and dot shrinks to a little over half the original size (64 percent). Microsoft documents have suggested Windows might someday be rewritten to solve this problem by separating the size of the fonts from the resolution. Screen displays will behave the way printers do now, so that increasing the resolution will leave the text the same height but provide sharper characters with finer details. The main Microsoft tools including Office and Internet Explorer support this approach by providing a zoom feature that enables you to increase the display of the font without changing the font size.

The **aspect ratio** is another topic in graphics that has become important—largely because it has been changing. The aspect ratio is the ratio of the horizontal width to the vertical height of an image. It is usually expressed in terms of two numbers, such as 4:3. Early film projectors were limited by the physical size of

Reality Bytes: SSD Performance Surpasses Hard Drives

In the first quarter of 2011, Micron Technology, the leading U.S. manufacturer of RAM, began shipping the RealSSD C400 flash drive. The 1.8 and 2.5-inch drives connect to laptops using SATA 3 which supports a data transfer rate of 6 G bit/second. The drives are created from NAND flash chips using a 25 nanometer lithography technology. The largest drive capacity is 512 GB and offers sequential read speeds up to 255 MB/sec and write speeds up to 215 MB/sec. These speeds are faster than hard drives and the half-terabyte capacity puts it in the range of many existing hard drives. On the other hand, the $900 consumer price (for 512 GB) is substantially higher than a hard drive cost; but a significant drop for SSDs.

Adapted from Lucas Mearian, "Micron Releases Half-terabyte Laptop SSDs," *Computerworld*, January 4, 2011.

the film so the 4:3 ratio was selected to fit the film's properties. Photographs often had a similar ratio. Television adopted the same ratio. Movie studios then adopted a widescreen format with a 1.85:1 or 2.40:1 ratio. When computer displays arrived, they followed the standard television 4:3 ratio; eventually leading to resolutions of 640 x 480 and 1600 x 1200. Then HDTV was introduced, partially with the goal of displaying higher-quality images for movies. The standard aspect ratio adopted for HDTV was 16:9 (or 1.78:1). Eventually, computer monitors and laptop screens adopted the same aspect ratio. But, a tremendous variation still exists in aspect ratios among monitors, laptops, tablets, and cell phones. As a designer you cannot count on a specific resolution or aspect ratio. Which often means it is necessary to create images and layouts in multiple formats; or to choose a size that will fit reasonably well on the most common displays.

Color

Color is an important component of images and video. It is also important in Web sites and graphics design of print pages. To date, most organizations rely on black-and-white for basic internal reports and memos. However, as color printing costs decline and as organizations move towards electronic documents, color is becoming popular in many reports. To begin to understand color, you need to study art and graphics design. In particular, color and design convey emotion, so you need to be careful about overall color schemes. Fortunately, most software packages support **templates**, so you can choose a template that fits your needs without needing to be a design expert. However, for complex designs and documents that are published, you should get expert advice.

Figure 2.11 provides a brief introduction to three of the basic color models. These models are used to identify colors, but do not do much to help you choose colors appropriate to your job. In the computer world, **RGB** (red, greed, blue) is the most common model. You should use a color picker to explore how the colors work so you can find or adjust colors when you need them. Think of each color byte as a spotlight. Increasing a single value increases the brightness of that color. **CMYK** (cyan, magenta, yellow, key) is commonly used by print shops, so if you create large print jobs that need to be sent to a print shop, you should work with the CMYK model. Each color number represents the percentage strength of the specified color. The challenge to printing is that your display screen rarely shows

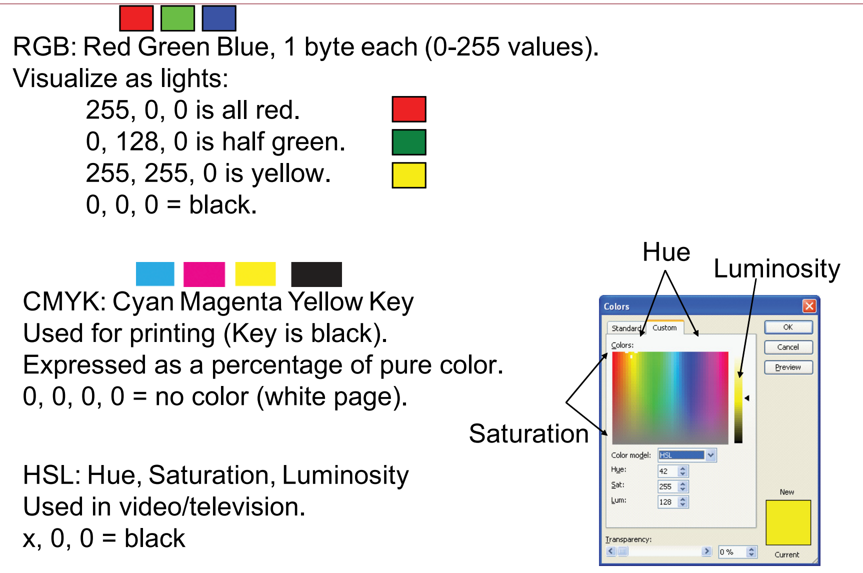


Figure 2.11

Colors. RGB and CMYK are the primary color models in use. RGB for computer colors created by generating light, and CMKY in printing for reflected light. HSL is used predominantly in the video world. Most software enables you to choose a color model and enter values the way you prefer.

colors the same way they will appear in print. Different lighting strongly affects the color and brightness of printed images. It also affects your display, but usually to a lesser degree. If you need to see colors as they will appear in print, you have to run a gamma correction program on your monitor. It can adjust the display to match the desired output characteristics. High-end graphics packages, such as those produced by Adobe, automatically install the gamma correction software and provide instructions for adjusting it. A related problem you will face with printing is that some colors you see on your monitor cannot be reproduced by printers. For example, a pure high-intensity blue is usually printed in a darker shade. The better graphics packages will show you the constrained color palette. You probably do not need to become a color expert, but these concepts explain why your system will sometimes display colors differently than you expected.

Style Sheets

When working on large documents, Web sites, or portfolios, consistency becomes a critical design factor. Actually, even a small document quickly becomes ugly and impossible to read if someone uses multiple typefaces, font sizes, and discordant colors. But the challenge with large documents is that it can be difficult to remember exactly which fonts were used for each element. It is even more difficult if the document or Web site is created by multiple people. **Style sheets** were designed to solve these problems and ensure consistency across a collection of documents. Style sheets have been used for many years in the publishing industry, but computer tools have made them more powerful and easier to use.

Reality Bytes: Choosing the Right Tools at Thule

In computer programming terms, the term "spaghetti code" represents logic that wanders all over the place—much like a plate of intertwined spaghetti. This code is hard to read and difficult to debug or change. Programmers are taught to write clearer structures that are easier to follow. But, most people who use spreadsheets learn just the basic concepts of the tools and then go and build complex monsters. Bicyclists and Skiers know Thule as a company that makes high-end bike and ski racks for cars. The Thule Vehicle Solutions North America division has 400 people and generates 15 percent of the corporate revenue. Vice President of Finance, Mark Cohen, notes the importance of the data, particularly for budgeting and forecasting: "We're a seasonal company, so we have to have product ready to go or the sale will go to our competitor." (The main competitor is Yakima.) Cohen noted that this data was maintained with spreadsheets. "We had one person in accounting who kept all the data as up to date as possible, including departmental expenses that outlined the costs of running the factory. However, it wasn't unusual for it to take a week to consolidate cross-company information, and it wasn't unusual to discover that what managers were looking at wasn't the final spreadsheet." In 2008, Cohen threw out the spreadsheet approach and went with an online system from Host Analytics Budget that provides real-time collaboration and mobile access to the data and projections. Individuals are now responsible for entering their own data and everyone gets immediate access to current values. The problem with the spreadsheet is that it was the wrong tool for the job. Yes, it could generate forecasts, but the bulk of the requirements were to collect and share current data—something spreadsheets do poorly.

Adapted from Sandra Gittlen, "Why Some Companies are Ditching Their Spreadsheets," *Computerworld*, January 19, 2011.

The basic goal is to predefine all of the styles that will be needed in a document and store these definitions in one location. When creating a document or Web page, you simply write the content and assign the appropriate style from the list. For example, first-level titles might have a *Heading 1* style. The typeface, font, color, and other attributes are defined within the style. By assigning the style to a section of text, that text is displayed correctly. The power of a style sheet is that a graphics designer can tweak the entire layout and design simply by modifying the style definitions in one location. Then every page automatically picks up the new style. Without a style sheet, making a design change requires searching every single page and editing multiple locations.

If your job consists of creating content—writing articles, presenting data, and so on—you simply have to use the predefined styles. But you must always be careful. Any special font or emphasis that you want to add should never be made directly to the text. Every design element has to be defined within the style sheet and then attached to specific objects. Any change that is made directly to a document, such as setting a word or letter to boldface, will be almost impossible to find and change later. Unfortunately, existing tools such as word processors make it relatively easy to select a word and set it to bold or italic—which bypasses the style sheet. You should avoid this temptation and instead open the style sheet list and assign a style instead of assigning bold or italic.

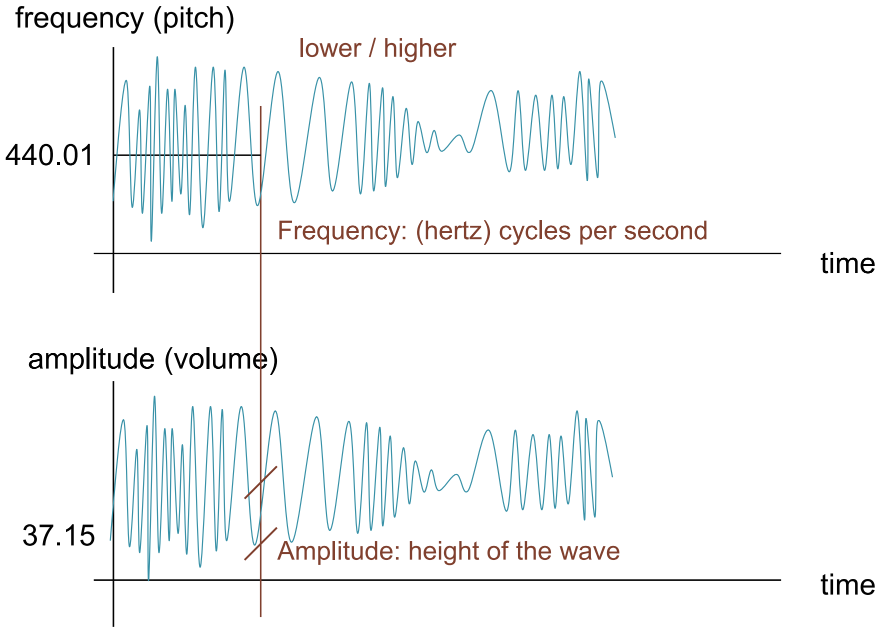


Figure 2.12

Sound sampling. At a specific point in time, the system measures frequency and amplitude using 16-bit numbers. The quality of the sample is largely determined by the number of times per second the audio is measured. The CD standard is 44,100 times per second.

Sound

Digitized sound is increasingly important for computer users. For example, you can use music to add emphasis and entertainment to a presentation. More important, you can use your computer to send voice mail messages and to store notes with your e-mail and documents. Tools exist to convert text to voice—so you can have your computer read your e-mail messages over the phone. Increasingly, voice input is being used both to control the computer and for dictation. Increased storage capacity and declining costs make it easier for sound to be stored in digital format.

As shown in Figure 2.12, sound consists of two basic components: volume (amplitude) and pitch (frequency). These two values are changed over time to produce words and music. To digitize sound, volume and pitch are measured several thousand times per second. The resulting binary numbers are stored in sequence. Synthesizers convert the sampled numbers back into music or speech and play them through amplifiers and speakers. The challenge is to sample the source often enough so no important information is lost.

Most audio applications store sound by digitizing the sound waves. These files can become very large—depending on the quality. If you tell the computer to sample the sound more often, you will get a higher quality recording, but it can take considerably more storage space. Sound-recording systems generally allow you to specify the sampling parameter to control the initial quality. From that point,

Object	Raw	Compressed	Lossy
Text and numbers	5 KB/page	2.3 KB/page	N/A
Image (300 dpi, 24-bit color, 4 x 6 in.)	6.32 MB	2.4 MB	78-245 KB
Sound (44.1 KHz stereo)	170 KB/sec	100 KB/sec	0.01 KB/sec
Video (NTSC 30 fps, stero sound)	25 MB/sec	3.7 MB/sec	1 MB/sec
HDTV (1080p: 1920 x 1080) MP4	6.8 GB/min		1.5 MB/sec

Figure 2.13

Size complications. Lossy compression results in substantially less data but at a lower quality. Text file is compressed with a Zip folder. Image is compressed with JPEG from high to low quality. Sound is compressed with a WAV file (44.1 kbps) and WMA (64 kbps). Video is compressed with the DV standard and WMV at 6383 kbps.

compression methods can be used to reduce the file size; but some of them result in a loss of quality.

An even more efficient method of storing music is to file it in the musical instrument data interchange (MIDI) format. MIDI is a method of specifying music based on the musical notation and instrument, so it is substantially more efficient. A version of this method was designed for the MP4 standard, but this standard has not been widely adopted.

Video

Computerized video has dramatically increased in the past few years, even in business. However, most of the video is relatively low quality, in terms of low resolution and low frame rates. Some video applications are better than others, but it is still challenging to transmit high-quality video. Yet, as transportation costs increase, there is considerable incentive to use video communication for some types of meetings.

Converting motion picture and television signals to binary form generates a tremendous amount of raw data. The process is similar to that for single pictures, except standard movies display 24 frames (images) per second, while U.S. televisions display 30 frames per second. Video can also be completely computer-generated. These tools are commonly used in marketing and engineering to display prototypes and product features.

It is relatively easy to display video—even cell phones have enough processing power to display high-resolution video. **High-definition TV (HDTV)** has become popular, and most devices have the ability to play standard HDTV files. Even relatively inexpensive cameras have the ability to capture images in HDTV format. The challenge arises in trying to edit video—particularly HDTV files. Editing requires that the files be decompressed and edited in raw format, which is a large amount of data. The next sections illustrates some of the issues with data size.

Size Complications

To understand the importance of the five types of data, it helps to examine the size of each type. For many years, computers predominantly handled numbers and limited text. Over time, usage has gradually changed to include images, sound,

Figure 2.14

Data compression. Storing every single pixel requires a huge amount of space. Compression looks for patterns. For example, instead of storing 1,000 black dots in a row, it is much shorter to store a note that says 1,000 black dots come next.

and video. The more complex data types require much greater storage space, processing power, and transmission capacity.

Consider a typical single-spaced printed page. An average page might contain 5,000 characters. A 300-page book would hold about 1.5 million characters. Now, consider a picture. At 300 dots per inch, a full 8.5- by 11-inch page would require a little over a million bytes if it were scanned in black and white. A photograph in a base resolution with 16 million colors (24 bits per pixel) would require 18 **megabytes** (million bytes) of storage space.

Sound and video require considerably more storage space. Remember that thousands of numbers are being generated every second. A typical CD holds 700 megabytes of data, which can store 72 minutes of stereo music or almost 10 megabytes per minute. At lower quality, the current standard for digitizing telephone conversations generates 64 kilobits per second, almost half a megabyte per minute. Video generates approximately 3 megabytes of data every second, while the highest resolution HDTV generates about 113 megabytes per second. Figure 2.13 summarizes the basic size characteristics for the standard data types.

Data Compression

An individual photograph at high resolution takes a large amount of space in raw form (typically over 20 megabytes). Storing and handling raw video creates substantially larger files. The answer in many cases is data compression. Look at the photograph in Figure 2.14 for a second. Consider the line of data from the lower left corner. To store it as raw pixels, you would have several lines of black pixels. Instead of recording every one of these pixels, data compression builds up patterns. It takes less space to encode a note that a section contains a large set of black pixels, than to store every pixel. Some systems, such as the JPEG method, support lossy compression. In these cases, patterns are matched as long as the pixels are "close" to an existing match. When you compress the data, you get to select how close of a match to allow. For example, with a tight match, the system might allow a very dark gray pixel to count as black, but might not allow a dark blue one to match a black pattern. Lossy compression methods are commonly used to transmit photographs, audio files, and videos.

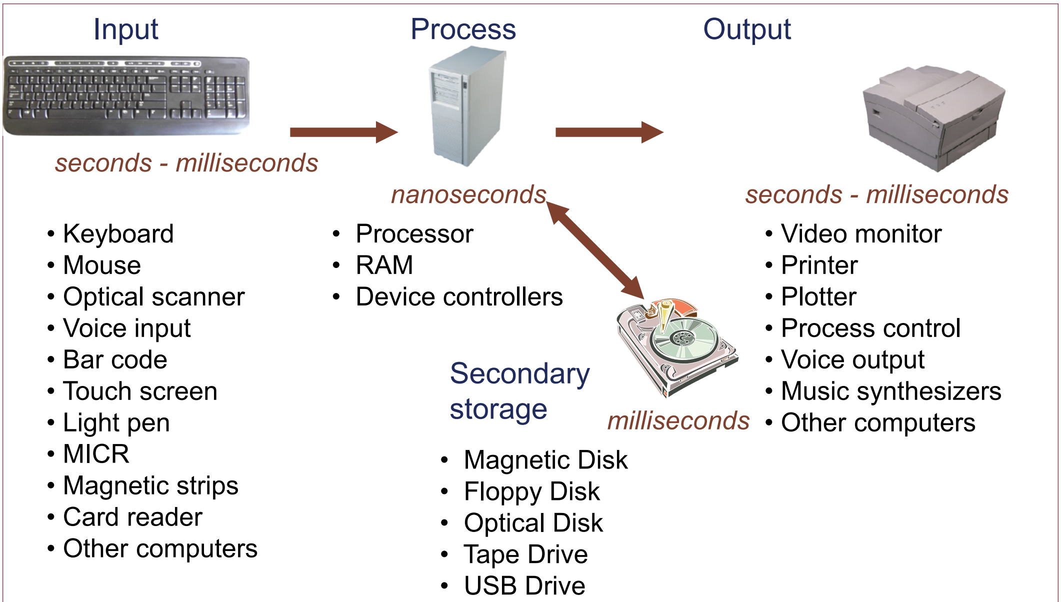


Figure 2.15

Computer performance and capabilities are highly dependent on the peripheral devices. Most computers will use several devices in each of the four major categories. Technological progress in one area often results in changes to all four types of components.

Hardware Components

What are the main components of a computer? As a manager, you need to understand the basic features of hardware. You do not have to be a computer-repair expert, but you need to understand the fundamental structure and characteristics of the computer components. The most important first step is to recognize that declining prices rule this industry. Because of technological advancements and standardization you know that you can buy a new computer next year that is faster than the one you just bought today. Instead of worrying about your "new" computer becoming obsolete, just accept that you will be able to buy a faster computer next year, which raises the questions: How often should you buy a new computer and what features should you buy? The answers to these questions change over time and depend on your specific uses, but as long as you understand how to evaluate the major components, you will be able to make a rational decision.

Along with declining prices, one of the most important trends in hardware is the shrinking size. But regardless of the size, computers contain four primary types of components to handle: input, output, processing, and secondary storage. Of course, each category has hundreds of options so that you can tailor the computer to your specific needs. One trend that you have to remember is that the hardware industry changes rapidly, especially for small systems. Most computers that you buy today will have a short economic life—perhaps only three years. At the end of that time, each component will have changed so much that typically you will want to replace the entire computer.

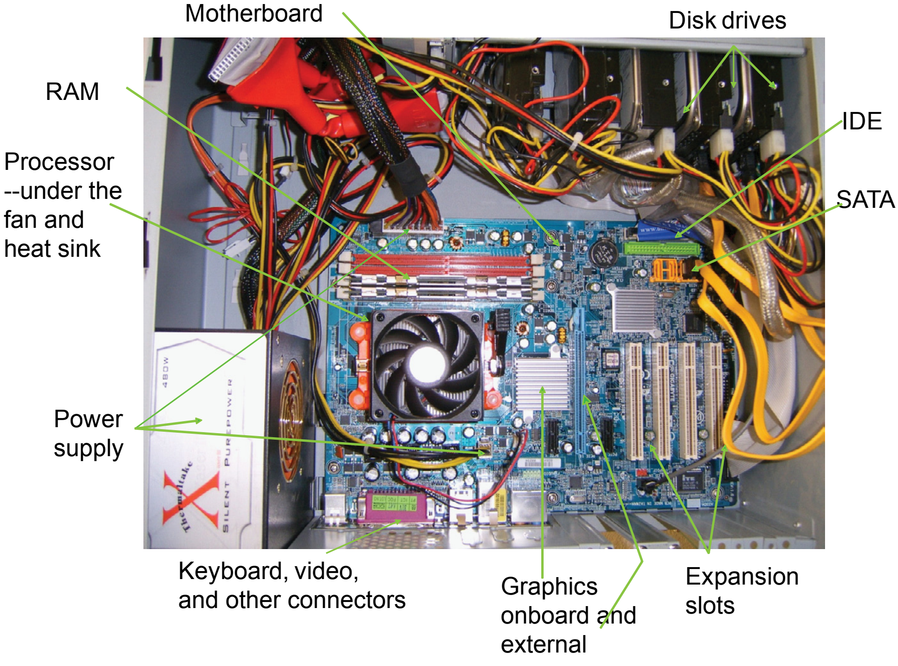


Figure 2.16

Basic computer components. The motherboard has the connectors to integrate all of the components. Expansion cards can be added for graphics processors, TV tuners, and other add-on tools. The processor has a large heat sink and fan to cool it. RAM is added to the board on strips. Disk drives are generally connected by serial (SATA) connectors, but older drives might use parallel IDE cables. The motherboard also has connectors for front-panel items such as lights and USB ports (hidden under the wires in this photo).

The relationship among the four components is summarized in Figure 2.15. Note that the process subsystem consists of **random access memory (RAM)** and at least one processor. In many ways, the **processor** is the most important component of the computer. It carries out instructions written by programmers. It uses RAM to temporarily store instructions and data. Data and instructions that need to be stored for a longer time are transferred to secondary storage.

One of the interesting aspects of computers is that the various components operate at different speeds. The processor is the fastest of the group and its performance is measured in **nanoseconds** (billionths of a second). Processors are even faster than RAM. As a result, processors contain separate memory caches embedded in the chip. When the processor asks for data items from RAM, it loads a large chunk of data at one time so that it can fetch related items from its internal cache to save time. Secondary storage devices are substantially slower. Because most disk drives are mechanical, performance time is measured in **milliseconds** (thousandths of a second). Divide those numbers, and you see that the processor is a million times faster than the disk drive! Of course, humans are even slower—most people type a couple of characters per second. Why do these speed differences matter? It means the processor can be told to do multiple tasks—apparently at the same time. While you are typing, the processor can take a fraction of its time to store your keystroke, then retrieve some data from the disk drive, then send an item to the printer, then add some numbers together, and finally return to get another keystroke.

Figure 2.16 shows the basic components of a PC. The **motherboard** contains connectors for the processor, RAM, drives, and expansion cards. Many boards also contain built-in graphics processors; however, add-on graphics cards generally provide better performance. The processor is relatively small—about the size of a 50-cent coin, but it is covered by a large metal heat sink and the processor fan to remove heat. RAM is added by installing strips. RAM styles change over time to provide better performance, so you need to get the right type of RAM for each board. Disk drives require a power connection and a data connection. Serial (SATA) connectors are commonly used now because they can move data faster than the older parallel IDE connections. Video connections and other data connections for networks and USB devices also change over time as new devices and technologies are introduced.

Warning: You should avoid taking apart your computer; and if you do—be sure to unplug it first! You also have to "ground" your body before touching any computer component. Static electricity can instantly destroy almost any electronic item. But, if you are careful, it is relatively easy to install new disk drives or even RAM into a computer. But always remember that you can never force a part to fit. Computer parts are designed to fit together with almost no effort. And remember that static electricity is your enemy.

Processors

Processors come in a wide variety of formats, but most of the existing mainstream processors (Intel and AMD) can run the same code sets. Increasingly, manufacturers are placing multiple processors on a single chip. So a single processor chip can contain 2, 4, 6, or more independent processing cores.

Processors are relatively complex today and include many components. **Cache memory** is a factor that influences the overall performance. The processor runs faster than any other device in the computer, including RAM. Any time there is a large speed difference performance can be improved by adding a memory cache to the faster device. The processor chip contains several megabytes of high-speed internal memory. When it retrieves data from RAM, the processor grabs the data in large chunks. It then works from the internal (level 2 or level 3) cache, which it periodically refills.

The processor is the component that does the hard work of calculations and executing the software code. You can check on the status of your processor and its various tasks by opening the Task Manager. Right-click on the Windows menu bar and select the Processes tab, but be careful not to end any of the processes or your computer might crash. Most of the time the System Idle Process will be the main user—which means the processor is simply waiting. You can also watch the performance chart to see the total demands placed on your processor. Windows has a sidebar gadget to let you monitor your processor all the time. If you find that the processor is consistently in heavy use, you should consider buying a new machine. However, unless you are running huge computational tasks or video-intensive applications, it is more likely that something is wrong with your computer and you should check it for viruses and spyware software described in Chapter 5. Typical users will find that they have plenty of processing power for almost all tasks.

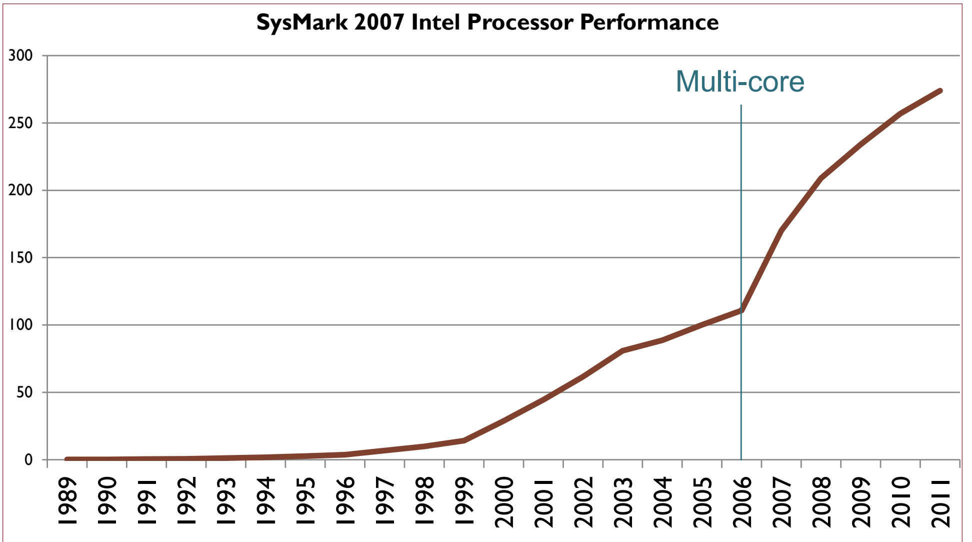


Figure 2.17

To assist buyers, Intel provides a measure of its own processors. The rating is an index that measures relative performance. A processor with a rating of 200 would generally be about twice as fast as a processor with a rating of 100. Of course, your other devices also influence the overall system speed, so just buying a faster processor does not guarantee that your machine will run faster.

The Evolution of Processors

Figure 2.17 shows an approximate measure of Intel processor performance over time, as indicated by an index value (estimated SysMark). The exponential increase in performance arises because the industry has been able to follow Moore's Law: the number of components placed on a chip doubles every 18 months. But three potential problems are facing the chip industry: (1) light waves are too wide to draw increasingly smaller lines; (2) when the components shrink to the size of a couple of atoms, the electronic properties no longer behave the same (quantum effects); and (3) the power requirements and heat generation increase dramatically.

For at least two decades, the IT industry has lived with and relied on this increasing performance (and reduction in costs). Eventually, this pattern will stop—possibly within 10 or 20 years. With luck and research, the industry will develop entirely new technology that will produce even greater performance. But in any case, managers need to monitor technical developments and be prepared for substantial changes.

The industry is switching to new chemicals to improve the electrical properties of the chips to buy some improvements. Several researchers are experimenting with optical computing (using light instead of electricity), and more esoteric concepts such as quantum computing and biological processors.

In practical terms, the biggest change to processors has been the switch to multi-core processors—where each chip contains multiple independent processors. Dual core processors gained importance in 2006, and the quad-cores made it to standard production in 2007. Experimental designs have been built with dozens, and potentially hundreds of processor cores on a chip. These features are discussed in the section on parallel processing.

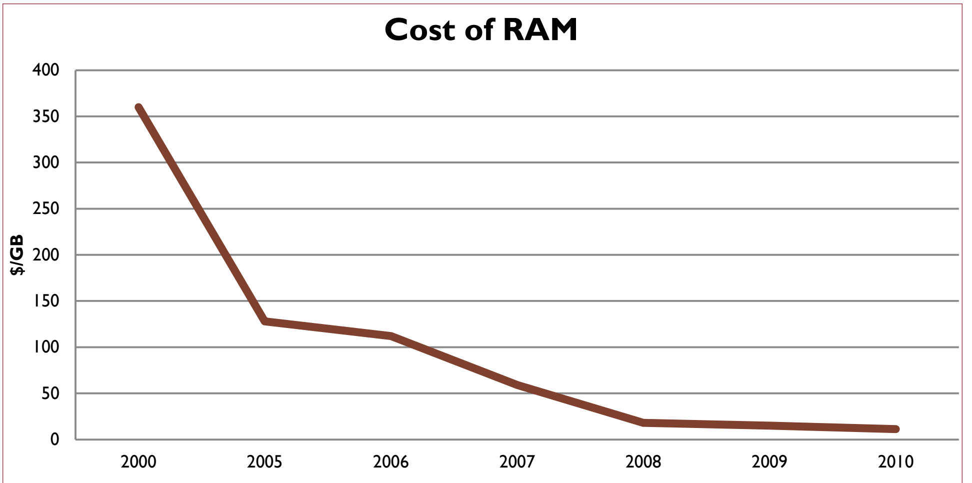


Figure 2.18

RAM prices over time. RAM prices have dropped at exponential rates as manufacturing processes have evolved, even as RAM speeds have increased.

Random Access Memory

As processor speed has improved, RAM has become a crucial factor in system performance. Because disk drives are mechanical, they are the greatest bottleneck in a computer system. Hence, modern operating systems try to hold as much data as possible in RAM. Figure 2.18 shows that RAM price has dropped substantially over the last decades. In relative terms, RAM is virtually free. For a couple hundred dollars, you can easily buy enough RAM to hold several applications and their data in RAM at one time. Operating systems, particularly Windows, take advantage of RAM to cache as much data and code as possible. Disk drives are notoriously slow, so system performance is dramatically improved by adding RAM. High-speed RAM enables the processor to pull data from RAM faster, leading to improved performance, but it is relatively more expensive.

Parallel Processors

In the past, when processors were more expensive, designers used only one processor in a machine. Today, many computers contain multiple processors. Although it can be a desirable feature, you must be careful when evaluating parallel-processing machines. If a computer has four processors (or four cores), it is tempting to say that the machine is four times faster than a computer with only one processor. Indeed, many computer companies advertise their computers this way. Can a computer with four processors really do your job four times faster? The answer is that it depends on your job. Consider an example. A computer with two processors has to add two sets of numbers together. Each processor works on one pair of numbers and finishes in half the time of a single processor. Now, the same two computers have to work the problem in Figure 2.19.

Notice that the second calculation depends on the outcome of the first one. The second one cannot be computed until the first one is finished. Even if we assign one processor to each calculation, the parallel-processing machine will take just as long as the single processor. On the other hand, if you commonly run multiple

Technology Toolbox: Voice Input

Problem: You are a slow typist or need to use your hands for other tasks.

Tools: A voice input system is built into Microsoft Office. You need a decent microphone to use it, and a headset microphone is recommended because it minimizes external noise. The system is relatively easy to set up, but it takes a half hour to train so that it recognizes your voice. Remember that no voice system is perfect, so you will still have to edit the text that it enters. You can find information on speech recognition in the Office help system by searching on the "speech" key word.

You can install the speech recognition software within either Word or the Microsoft Windows Control Panel. Within Word, select Tools/Speech. From the Control Panel, select Add/Remove Programs, find Office and Change it. Use Add or Remove Features and find the option to add Speech under the Alternative User Input. Once the software is installed, you have to train it. Follow the installation instructions to perform the basic training. To improve recognition accuracy, you should also take the time to read at least one of the additional training documents. Once the system is installed and trained, you can dictate text into an Office document. Remember that the system works better if you dictate complete sentences.

The voice toolbar enables you to turn the microphone off, so that you can speak to someone else or cough. Notice that it also enables you to switch between Dictation and Voice Command modes. The help system provides additional information about command mode and the additional things that you can say to control the computer with voice. For example, in Voice Command, you can say the word "font" followed by the name of the font to change the font in use. You can also start other programs and select items on the menu. The help documentation includes information on commands you can use during dictation. Some of the common commands are in the table.

Command	Result
period or dot	.
comma	,
new line	enter key/new line
new paragraph	Enter twice
open paren or parenthesis	(
close paren or parenthesis	)
force num, pause, digits	numbers (for several numbers in a row)
spel it or spelling mode	spell out a word
microphone	turn microphone on or off
correct that	change or delete the last phrase entered
scratch that	delete the last phrase entered
go to top	move to top of the document (or use bottom)
move up	move up one line (also accepts down, left, and right)
backspace	delete one character to the left
select word	select a word (or use phrase with several options)

Quick Quiz: Use the help system to find the commands for the following:

1. !, ?, #, $
2. Make a word boldface or italic.
3. Print the current page.

$$\begin{array}{r} 23 \\ +\,54 \\ \hline xx \end{array} \qquad \begin{array}{r} xx \\ +\,92 \\ \hline yyy \end{array}$$

Figure 2.19

Some computations must be performed in sequence, so there is little to be gained with multiple parallel processors. In this example, the second computation (yyy) must wait for the first one to finish.

applications at the same time, multiple processors will improve performance because each processor can handle the applications separately.

Massively parallel machines can include thousands of processors. They are used for some highly specialized applications. For example, governments use them to break codes; physicists use them to simulate large-scale events such as nuclear explosions and weather patterns; computer artists use them at special-effects studios, such as Industrial Light & Magic, to create movies. This concept has been extended with the use of **grid computing**, where thousands or millions of separate computers are assigned portions of a task. The search for extraterrestrial intelligence (SETI) project is the most famous example using a grid approach. Users are encouraged to download a small program that runs in the background on the computer. The program retrieves portions of radio-astronomy data from an Internet site and scans them looking for patterns. The millions of participating computers provide a huge (free) resource to process data that could not be handled by any other method. Using similar software, the grid concept can be applied to business and scientific applications. A company could use existing clerical computers or, since personal computers are so inexpensive today, could buy hundreds of machines and tie them together to handle large databases.

Today's computers take advantage of multiple processors in more subtle ways. Most computers today utilize a separate graphics processor to draw items on the screen. It is a sophisticated processor with its own RAM that handles complex three-dimensional calculations. This additional processor is particularly important for 3D graphics, such as those used in games. However, Windows Vista takes advantage of the processor for all display chores and offloads the drawing tasks to the graphics processor—creating faster graphics and enabling special effects within applications.

Connections

Even if two computers have the same basic components, it is still possible for one machine to be substantially faster than the other. The reason is that the components need to exchange data with each other. This communication typically uses a short-distance electrical connection. Most computers have special slots that form the connection between add-on boards and the processor bus. Various manufacturers make boards that fit into these slots. The processor can exchange data with these other devices, but it is constrained by the design of the bus. For example, even if a processor can handle 64 bits of data at a time, the bus might not have the connections to allow it to transfer that much data at a time. Standards enable users to exchange cards and devices from one computer to another. The problem is that a bus designed for today's computers will eventually become obsolete as the pro-

Method	Max Speed	Primary Purpose
PCI-e 2.0 x16	500 M Bytes/s * 16 64 G bits/sec	Connect peripherals, particularly graphics cards
SATA II	3 G bits/sec	Disk drives
SATA 3	6 G bits/sec	Disk drives
Fibre Channel	20 G bits/sec	Data center storage network
Firewire 2.0	800 M bits/sec	Video, drives
HDMI	3.4 G bits/sec	HDTV video
USB 2.0	480 M bits/sec	External drives
USB 3.0	4.8 G bits/sec	External devices
Intel Thunderbolt	10 - 100 G bits/sec	External devices
LAN/gigabit	1 G bits/sec	Computers, drives

Figure 2.20

Common methods to connect peripheral devices to computers. The max speed is never achieved but it can reveal bottlenecks. Hard drive transfer rates are often limited by drive write speeds. But the newer methods (SATA 3 and USB 3.0) will improve the performance of large data transfers—particularly with large solid state drives.

cessor improves. At some point, the standards need to be changed. In the personal computer market, standards for the bus have gradually evolved. For several years, the industry has relied on an Intel-sponsored design known as the *Personal Computer Interconnect (PCI)* bus. PCI was also designed to make it easier for users to set up their computers. Over time, manufacturers have increased the transfer speeds of PCI, but it is increasingly a limitation in computer performance.

External components also need to be connected to computers, such as thumb drives, external disk drives, cameras, and video cameras. For example, the IEEE 1394 or firewire standard is commonly used to transfer data from video equipment, but can also be used to connect disk drives to the computer. USB 2.0 is a similar standard used to connect peripherals including disk drives and RAM drives. Fiber channel and serial ATA are used to connect disk drives at high speeds. Ultra-wideband wireless (UWB) might eventually be used to connect devices at high speeds without using cables. For example, you could tell your video camera to send the signal to your television simply by setting it next to the TV and pushing a button. Figure 2.20 shows the common connection methods available and their maximum transfer rates. Be cautious with the transfer rate numbers. No system ever reaches those numbers, but they do impose a speed limit. For example, hard disk drives are limited by their write speed (perhaps 400 mbps), so a SATA 3 connection will provide no improvement over a SATA II cable. But you would see better performance if you connect that drive through USB 3.0 or eSATA than with USB 2.0. With overhead transfer costs, USB 2.0 is probably restricting the data transfer. The basic rule is that when you purchase newer, faster peripherals, you need to connect them through faster cables. So do not expect to be happy connecting a new high-speed device to a three-year old computer running USB 2.

Reality Bytes: People Can't Memorize Computer Industry Acronyms

The computer industry lives on acronyms. Any time a new product is created, a new acronym is developed so that everyone can use shorthand letters to refer to it. TLAs (three-letter acronyms) are best, but sometimes they are longer. Actually, every industry uses acronyms to save time when communicating—but the computer and network industries change so quickly that they continually develop new products and new acronyms. But, ordinary people have considerable difficulty memorizing the acronyms. Read any computer ad and try to figure out the specifications if you do not know the acronyms. Mike Molloy, USAF, Ret. and his wife, Susan Ebert, have come to your rescue. They have created a Web site, www.AcronymFinder.com, that lists any acronym you can imagine and the various interpretations. Many acronyms have multiple definitions—depending on which industry or field is using it. If you spend hours a day writing text messages, you might think you are an expert on acronyms, but remember that new ones are introduced every day. As a central source, where all of the acronyms are validated by Mr. Molloy and his wife, the site can save you time in your research.

Adapted from Barry Newman, "BTW, if You Need Info About C4ISR, Read This ASAP," *The Wall Street Journal*, January 13, 2007.

Input

A variety of input devices are available because of the need to handle the many data types. Hundreds of variations exist because of the challenges of adapting the devices to human needs. People have different preferences and styles, so manufacturers are constantly improving their products. The purpose of an input device is to convert data into electronic binary form. Keyboards are the most common method of entering new text and data. Note that you can purchase different types of keyboards to suit individual users. For example, some keyboards enable you to change the layout of the keys. Keyboards have their own feel; some individuals prefer sensitive keys requiring a light touch, while others like stiffer keys to support their hands.

Ergonomics is the study of how machines can be made to fit humans better. One of the main conclusions of this research in the computer area is that individuals need to be able to adjust input (and output) devices to their own preference. Forcing people to adapt to rigid devices can lead to complaints and even physical injuries. Since the mid-1980s, some workers have encountered a disabling condition known as repetitive stress injury, which some people claim results from extended use of tools that do not physically match the worker.

Although there is limited scientific study of these injuries and causes, some people have found relief after ergonomic changes to their work environment. Complaints typically involve back pain, eye strain, headaches, arm and shoulder pain, and finger or wrist pain due to carpal tunnel syndrome. Common ergonomic suggestions include adjustable chairs, footrests, armrests, adjustable keyboards, high-resolution low-flicker monitors, and improved lighting. Most of these adjustments are relatively inexpensive today, but can add up if new chairs and desks are needed for thousands of workers.

Pointing Devices

With the increased use of graphics and pictures, it is common for computers to use pointing devices for input. A mouse is the most popular device in use today, although pressure-sensitive pens, touch screens, and digitizer tablets are heavily used in some applications. Touch screens are commonly used for displays that involve customers or other atypical computer users, but they are also common on tablet PCs. Many tourist bureaus, hotels, and shopping areas use computer displays with touch screens to give directions to visitors. Besides the fingerprints, the biggest problem with touch screens is that the tip of your finger is often too large to be a useful pointer. For more detailed use, an engineer who is designing a wiring diagram for an automobile would use a digitizer tablet with a special pen to draw fine lines and select individual points that are close together.

Scanners

When you are dealing with pictures, it is often helpful to have a scanner convert a paper-based image into digital (bitmap) form. For certain types of images (line drawings and text), vector tracing software can convert the bitmap image into vector form. Most digital cameras also have the ability to take photographs of paper documents. The benefit of the camera approach is that the camera is much faster at capturing the image. Some photocopiers use a similar process to enable workers to scan documents and e-mail them to a computer.

The quality of a scanner is measured by the number of pixels per inch that it can distinguish as well as the number of colors. Most scanners can read at least 600 dots per inch. More dots mean you get finer lines and sharper pictures.

Scanners also can be used to input text and data into a computer. The scanner first converts the page into a picture of dots. Then **optical character recognition (OCR)** software examines the picture and looks for text. The software checks each line and deciphers one character at a time. Although OCR software is improving, it is not 100 percent accurate. Some systems automatically look up each word in a dictionary to spot conversion errors and improve accuracy. Even then, users report about a 95 percent accuracy rate—which is highly dependent on the quality of the original document.

Digital cameras can also function as scanners. The principle is the same—the camera has a sensor that captures individual pixels. Most cameras have a setting optimized for taking pictures of black-and-white pages of text. It can be useful for quick captures of a couple of pages, or for storing notes taken on a board.

Sound

Sound is initially captured with a microphone that converts sound pressure waves into electrical signals. A *sampler* then converts these signals into numeric data that can be stored on the computer. Musical **synthesizer** technology is used to convert the numbers back to electrical signals that can be heard with speakers. Sound boards can be purchased for personal computers that contain both the sampler and synthesizer technology. Digital sound conversion occurs on almost every long distance telephone call you make. Your voice is converted to 1s and 0s to be sent across fiber-optic telephone lines.

Speech Recognition

As long as computers have existed, individuals have dreamed of being able to talk to them and have their words translated into text. Today, computers can digitize

Reality Bytes: People Really do Want Digital Content

For several years, book publishers have resisted shifting to digital books. Part of the reason is because several early e-book readers were weak, had limited support, and were not adopted by customers for those reasons. After Amazon introduced the Kindle e-book reader, and then dropped prices with the second and third versions, people began buying them in large numbers—although Amazon does not report the actual number of Kindle sales, which are estimated to be in the millions. Several other companies, including Apple through its iPhone and iPad apps also provide reading devices for digital text. At the end of 2010, Amazon reported that it had sold 15 percent more Kindle e-books than paperbacks. By the middle of 2011, Amazon reported that sales of e-books exceeded the sales of all print books. And that is not counting downloads of the free, public domain e-books.

Adapted from Matt Hamblen, "Amazon.com Touts More e-Book Sales than Paperbacks," *Computerworld*, January 28, 2011.

and record speech, and they can convert spoken words into computer text. Some problems still exist, and the systems need to be trained to a specific user. Common problems include the use of homonyms, variations in speech patterns or dialects, and the effects of punctuation on meaning.

Initially, speech recognition systems were adopted by occupations that require note taking along with two hands to do the job. Quality control inspectors and surgeons use them regularly. As performance continues to improve, we will see an expanded use of speech recognition systems among all users. Ultimately, speech recognition will be a key element in dealing with computers. Keyboards do not work well in a wireless environment. They are too large to be portable and hard to use.

Today, speech recognition is built into the Windows operating system. Speech recognition generally requires you to train the system to recognize the way you pronounce various words and phrases. If you enunciate clearly and learn to dictate in complete sentences, speech recognition is relatively accurate. You can also use voice commands to start applications and issue simple commands to the computer. However, the industry still has a long path ahead for speech recognition to begin replacing keyboards.

Video Capture

As technology improves, companies are increasingly adding video clips to presentations and Web sites. Digital video transmissions are also being used for communication. Today, most television monitors can be used as computer monitors. The HDMI connector that is common on HDTVs is becoming a standard way of connecting video equipment, including computers. On the flip side, capturing or displaying television signals on your computer requires additional hardware—specifically a tuner or capture card. A common television digital video recorder (DVR) is really just a computer with a capture card and a large hard drive. The challenge is that the capture card has to be matched to the type of input: over-the-air digital broadcast, cable-TV digital signal, satellite signal, or video camera input. Throw in the complication that most digital broadcasts are encrypted, and it becomes difficult to build your own capture system. Interestingly, it is actually

Printer	Initial Cost (dollars)	Cost per Page (cents)	Quality (dots/inch)	Speed (pages/min)
Laser: B&W	300 - 20,000	0.6 - 3	600 - 1200	4 - 8 - 17 - 150+
Laser: Color	500+	5 - 75	600 - 1200	1 - 30
Ink jet	50 - 800	5 - 150	300 - 1200	1 - 20

Figure 2.21

Printer evaluations. Printers are evaluated in terms of initial cost, cost per page, resolution, and speed. There are many types of printers, led by laser, ink jets, and dot matrix printers. Prices vary depending largely on speed and resolution. Technological changes are leading to new varieties of printers that can produce full color at a cost of around 5 to 10 cents per page.

easier to deal with over-the-air HDTV broadcasts in 2011. The quality is generally good (often better than cable TV), the signal is not encrypted, and it is free.

Output

Most people are interested in two types of output: video and paper copy. Video output is created by a video card and displayed on a monitor. Computer projection systems for meetings and presentations use high-intensity light to project an image onto a screen. In addition to resolution, they are evaluated by the intensity of the light, measured in lumens. Other display technologies have been developed including heads-up displays for cars, personal projection systems that project an image from special glasses, and electronic ink that displays text and images on flexible displays.

The other common output device is the printer. Printers come in many different forms. The most common formats are laser and ink jet, where the output is created by printing dots on the page. Common resolutions include 600 dpi and 1200 dpi lasers. In contrast, standard typesetters, such as those that are used to print books, operate at resolutions of at least 2,400 dots per inch. Again, higher-resolution devices are more expensive. Also, the increased amount of data being displayed takes longer to print (for the first copy).

Laser printers operate much like photocopiers. In fact, newer copiers include hardware to connect to a local network so the departmental copier can function as a high-speed printer. From your desktop, you can tell the printer to make multiple copies and collate and staple them—at speeds of over 70 pages per minute. As noted in Figure 2.21, the initial cost is usually only a minor component of a printer's price. It is more important that you look at the cost per page—particularly for color copies.

Secondary Storage

Why are there secondary storage devices? Why not just store everything in high-speed RAM? The main reason is that standard RAM is dynamic—which means that the data disappears when the power is turned off. The second reason is cost: a terabyte hard drive costs less than $100. Even at today's relatively low prices, the equivalent amount of RAM would cost several thousand dollars. On the other hand, because disk drives are mechanical, they are slow and can fail. Some companies, notably Google, have invested in huge RAM drive storage. All of the

Drive	Capacity (gigabytes)	Speed (Write MB/s)	Initial Cost (dollars)	Cost/GB (dollars)
Magnetic hard	80 - 3,000	60 - 200	65 - 200+	0.07
SSD	16 - 512	60 - 320	200 - 900	1.76
USB drive	2 - 64	25 - 150	10 - 115	1.80
Tape	250 - 2,000	20 - 120	300 - 5,000+	0.50 - 1.00
CD-ROM	0.70	2 - 8	50	0.18
DVD	4.77 (8.5 DL)	2 - 21	50	0.04
Blu-Ray	25 (50 DL)	4.5 - 36	80	0.12
Blu-Ray BDXL	128			

Figure 2.22

Secondary storage comparison. Hard drive prices and speed make them the best choice for secondary storage. Tapes make good backup systems because of the cost per gigabyte and 50-100 gigabyte storage per tape, but the sequential storage makes it harder to retrieve data.

search indexes are stored in RAM, resulting in substantially faster searches instead of relying on disk drives.

Hard disk drives are the most common method of secondary storage. The primary drawback to disk drives is that data transfer is limited by the physical need to spin the disk and to move the read/write heads. Besides being slower, mechanical processes are sensitive to movement and deteriorate faster than pure electronic systems. Consequently, several manufacturers have developed static memory chips that hold data for portable devices—like Sony's memory stick. The USB drives are a popular method for transporting data and have quickly replaced floppy disk drives.

A more recent variation is the **solid state drive (SSD)** which has even faster read/write speeds and is packaged similar to a standard hard drive. In particular, SSDs for laptops plug into the same slot as a standard hard drive. Today's USB and SSD drives are as fast or faster than hard drives—even for write speeds. So, the biggest problem is price. SSDs are roughly fifty times more expensive than hard drives. But, this price difference has been declining, and as vendors focus on improving the chips and the production capacities increase—these prices should continue to drop.

Except for prices (declining) and capacity (increasing), typical hard drives have changed little during the last few years. Secondary storage is needed to hold data and programs for longer periods. Secondary storage is evaluated by three attributes: capacity, speed, and price. Figure 2.22 shows the values for different types of storage.

With the increasing importance of data, companies are searching for ways to prevent loss of data by providing continuous backups. One straightforward method is to install an extra disk drive and keep duplicate copies of all files on this *mirror drive*. If something goes wrong with one of the drives, users simply switch to the other drive. A second method of protecting data is known as a **redundant array of independent drives (RAID)**. Instead of containing one large drive, this system consists of several smaller drives. Large files are split into pieces stored on several different physical drives. At the same time, the pieces can be duplicated and stored in more than one location. In addition to the duplication, RAID systems provide faster access to the data, because each of the drives can be searching through its part of the file at the same time. Essentially, RAID drives use parallel operations to dramatically improve the storage and retrieval of large documents.

On personal machines, even if you do not want to spend the money for a RAID solution, it can be a good idea to buy two hard drives instead of one large drive. Particularly for data-intensive applications like video editing, it is wise to put the operating system and application software on one drive and place the data files on the second drive. Two drives are better than one because the computer can retrieve the data simultaneously from both drives. In fact, video and large database applications often benefit from using three drives: one for the system, one for the main data, and one to hold temporary files. Putting everything on one drive forces the computer to trade between tasks and wait for the single drive to spin to the proper location.

Magnetic tapes are also used to store data. Their biggest drawback is that they can only store and retrieve data sequentially. That means you have to search the tape from the beginning to find any data. A single tape can hold 20 to 400 gigabytes of data. Compression can double or triple the capacity of a single tape, driving the cost per gigabyte from $0.50 down to $0.20 or lower. Because of these two features, tapes are most commonly used to hold backup data. Just be careful to store the tapes safely, and stay away from ultra low-cost drives that might fail.

With the increased use of images, sound, and video, there is a need for substantially greater storage capacity for data files. Optical disks have provided substantial capacity at relatively low costs. The optical (or magneto-optical) disk drive uses a laser light to read data stored on the disk. **CD-ROM** stands for compact disk-read only memory, the format used to store music CDs. The ROM portion of the name means that you can only read data from the disk. But, actual storage depends on the type of blank disk and your CD burner. Standard disks can be written once, or you can use rewritable disks. However, rewritable disks might not be compatible with other systems. The biggest drawback is that saving data to a CD is relatively slow. And, 700 megabytes does not go far these days.

The **DVD** (digital video disk or digital versatile disk) is a significantly better technology. DVD was created to distribute digitized video. Compared to CD, the strengths of DVD are (1) increased capacity, (2) significantly faster access speeds, and (3) standards for audio, video, and computer data. A basic DVD holds 4.77 GB of data. However, the commercial DVDs for movies can hold as much as 8.5 GB of data by using an advanced writing technique (dual layer).

Blu-Ray is the most recent format created for storing high-definition digital video data. Sony, the leader in the Blu-Ray consortium, reports that a dual-layer Blu-Ray disk can hold 50 GB of data—enough for about four hours of high-definition video recording. You can also purchase Blu-Ray recorders. The burners have dropped in price, but the blank disks are still expensive. Probably too expensive to use as backup devices. But, the prices should drop over time and it would be useful to be able to store 50 GB at a time on a backup disk.

Operating Systems

Why is the operating system so important? Computers follow instructions called software that are written by programmers. Every computer needs one

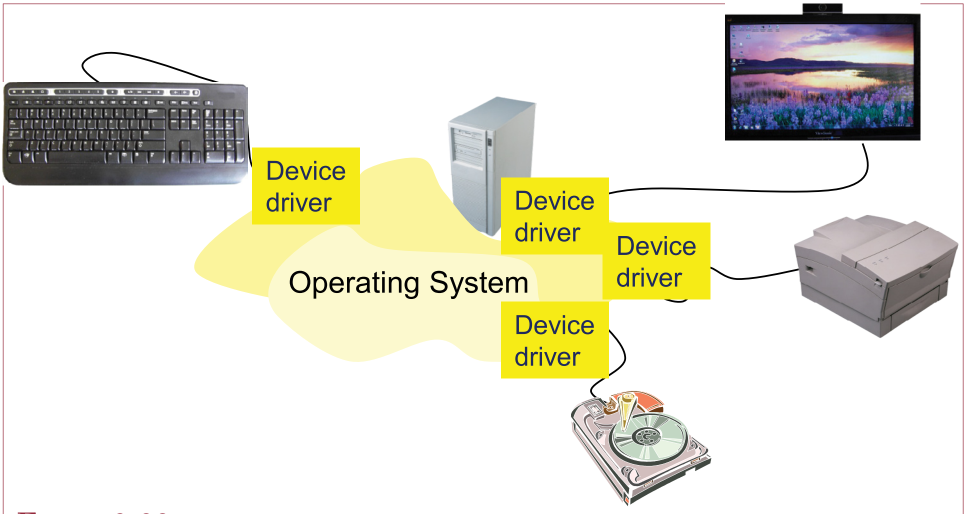


Figure 2.23

Operating system and device drivers. Every peripheral device uses device driver software to connect to the operating system. The software uses defined interfaces to transfer data and monitor status of the device.

special type of software known as the operating system. The **operating system (OS)** is software that is responsible for communication among the hardware components. The operating system is also a primary factor in determining how the user deals with the machine.

As shown in Figure 2.23, the OS handles the interaction with other devices through **device drivers**, which are small software programs that provide hooks that are called by the OS to execute commands on the device. For example, a printer driver provides a standard set of commands to the operating system, and handles the details of drawing text and objects on the specific printer. These software drivers are routinely updated by the vendors to fix bugs and add new features. The power of this approach is that any vendor can create a new device. By creating an appropriate driver, even older computers can take advantage of the new device.

Historically, each computer manufacturer created its own operating system tailored for that specific hardware. Proprietary operating systems caused many problems; in particular, changing vendors typically required purchasing new application software. AT&T researchers began to solve this problem when they created a hardware-independent operating system. It is known as UNIX and was designed to work with computers from many different manufacturers. However, UNIX is not a complete standard, and application software must generally be rewritten or at least recompiled before it can function on different computers.

Today, fewer operating system choices exist. Personal computers generally run a version of Microsoft Windows. The other main alternative is a variation of the UNIX operating system. Several years ago, much of the UNIX code was essentially released to the public (although a few lawsuits remain over exactly who owns parts of the code). Linus Torvalds used the code to create an inexpensive and rela-

Reality Bytes: Where Are You Going to Put Everything?

Most large corporations are reluctant to trust their data to anyone else. A survey of 247 Fortune 1000 firms by TheInfoPro in 2011 revealed that only 10 percent were even considering the public cloud for even the lowest tier of data. Most companies (73 percent) are relying on Fibre Channel storage area networks (SANs), even over network-attached storage (NAS). Although companies are unwilling to trust data to public cloud providers, they were willing to store data on private clouds.

Adapted from Lucas Mearian, "Fortune 1000 Firms Shun Public Cloud Storage," *Computerworld*, May 4, 2011.

tively popular version for personal computers. His base versions are called Linux and form the core of several open source systems. The Linux system is available in several varieties for personal computers. It is also embedded in many devices such as eBook readers. Apple computer also adopted the UNIX foundation with its OS X operating system. Most midrange computers and many servers also run an operating system derived from UNIX. Notably, IBM (AIX and Linux) focuses on UNIX versions for its servers. IBM also continues to support some older, proprietary operating systems. For servers and midrange systems, you still typically use the operating system provided by the hardware manufacturer.

The battle over operating systems continues today. At least some portion of Microsoft's market strength is tied to its ownership and control of the desktop operating system (Windows). The standardization of the operating system has made it possible for vendors to create thousands of useful software applications. The relatively open platform has encouraged the development of thousands of new hardware devices that can be easily installed in millions of computers worldwide. Yet the common operating system has also made it easier for hackers and viruses to attack millions of machines. And many smaller companies are concerned about the ability to compete against a company as firmly entrenched as Microsoft.

The operating system battle now extends into cell phones—which are essentially small handheld computers. For years, cell phone manufacturers used their own proprietary operating systems. As smart phones became more popular, the operating system became more important and vendors began to choose among a few standard versions. Apple phones use their iOS system; many other phones use the Android operating system developed and maintained as open source by Google. Microsoft also provides a Windows operating system for cell phones, and some vendors (notably Blackberry) use their own systems.

To a user or manager the choice of an operating system is probably not important. However, it does affect how you use the device, and it might limit the applications or software available for the device. In general, you pick a device based on reliability, capabilities, and the availability of the software you want to use.

Computers in e-Business

How does the Internet change the role of computers? The Internet and the Web changed computing and business in several ways. Beyond the issues of connectivity, the key feature of the Web was the introduction and acceptance of the browser. The reason the browser is so important is that it has become the standard display mechanism. Increasingly, applications are being built that rely

Reality Bytes: How Safe is Your Data?

Check out an ad for a disk drive and you will see many specifications. The mean time between failure (MTBF) is an important one because it indicates the reliability of the drive. Manufacturer data sheets often indicate MTBF between 1 and 1.5 million hours. However, a Carnegie Mellon study coauthored by Garth Gibson of 100,000 disk drives in data centers run by Google indicate that actual failure rates are substantially higher. The posted MTBF numbers would indicate annual failure rates "of at most 0.88 percent." In reality, typically 2 to 4 percent of the drives failed, with some systems having failure rates of 13 percent. Professor Gibson pointed out that not all of the drives had actually failed. Sometimes it is difficult to identify the cause of a problem and drives are removed in the testing process. Vendors report that as many as 50 percent of returned drives actually work fine. The dirty, hot, vibration-prone environment of a data center is also harder on drives than a clean-room testing center. Regardless of the failure rates, disk drives are mechanical so they are less reliable than pure electronic equipment. Consequently, you must always assume that a drive can fail and ensure that you have proper backups to recover your data.

Adapted from Robert L. Scheier, "Disk Drive Failures 13 Times what Vendors Say, Study Says," *Computerworld*, March 2 ,2007.

on the services of the browser. When the browser becomes the most important display device, then nothing else matters. To emphasize the point, in 2011, Google introduced an operating system for simple hardware that is based completely on their Chrome browser. All operations are designed to work across the Web. Although this approach might seem extreme to those used to working on traditional PCs, it is similar in many respects to mobile computing on cell phones and tablet computers.

A Web-based approach with a stripped down operating system has several potential benefits. The hardware can be simpler and cheaper. The computer and start up and shut down much faster. All data is automatically stored on central Web servers, which provide backup and access from any location. Software is upgraded and replaced on the servers instead of each PC.

In terms of drawbacks, the most important one is that you need good access to an Internet connection. Without the Internet, you might as well be carrying a brick. You also rely on the servers—both in terms of uptime and maintenance and in terms of pricing. Services that are free or low-cost today might suddenly become expensive if the service providers decide to charge higher prices. Your data is also no longer in your control—you run slightly higher security risks in terms of data transmission and data storage.

Many of these issues reflect ongoing decisions between centralization and decentralization, which are covered in more detail in Chapter 12. In the past, the decisions applied primarily within companies. The Web now makes them pertinent to everyone.

What Is a Browser?

At heart, browsers are simply software display devices. They read incoming files, recognize the data type, and display the data as instructed. The data could be text, images, sound, or even video. However, the sound and video are usually handled

Technology Toolbox: Creating Effective Charts

Problem: You need to create a chart that users can understand.

Tools: Spreadsheets contain powerful tools for creating charts; however, you must be careful when using the tools to ensure that the features are used to make the chart more informative and easier to read.

The first step in creating a chart is to enter the data correctly and perform any needed transformations. The second step is to choose the correct type of chart to emphasize your message. The third step is to clean up the chart and make sure it contains the proper title and labels. The table shows the main purpose for each chart type and the common mistakes made by novices.

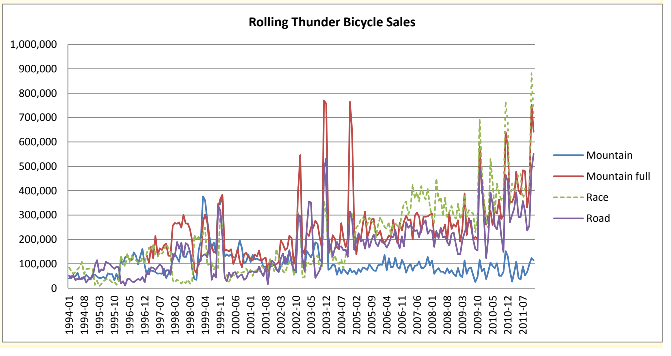
Chart Type	Purpose	Most Common Mistakes
Bar or column	Show category values.	Too many series Unreadable colors Not zero-based
Pie	Compare category percentages.	Too many observations/slices Unreadable features/3-D Poorly labeled
Line	Show trends over time.	Too many series Poor or missing legend Not zero-based
Scatter	Show relationship between two variables.	Poor choice of variables Not zero-based

One major mistake that is common to all chart types is to use excessive ornamentation. As Edward Tufte points out in his book The Visual Display of Quantitative Information, graphing software offers many temptations that should be avoided. Make sure every option you choose highlights the main purpose of the chart. Avoid cluttering your graph with excess lines, images, or garish color schemes. The goal of any design is to strive for elegance.

Creating a chart in Excel is straightforward. In this example, export the sales by model by month from Rolling Thunder Bicycles. Open the generated spreadsheet and select all of the data cells. Click the chart button and build the line chart. To simplify the chart, remove the Hybrid and Tour models.

Quick Quiz: Create the following charts:

1. Use the export data form in Rolling Thunder Bicycles to generate sales by state. Create a column chart and a pie chart for this data. Briefly explain why one chart is better than the other.
2. Using Bureau of Labor Statistics data, plot the unemployment rate and the hourly wage rate over three years.



Reality Bytes: GPU Processors Go High Performance

Gamers and other users of high-end graphics know that Nvidia is one of the largest providers of high-powered graphics cards. The cards are based on a graphics processing unit (GPU) architecture where each car contains many small high-speed processors. Although a high-end graphics card might appear to be expensive, on a per-GPU basis, the costs if considerably lower than for traditional processors. Consequently, Nvidia also builds specialty cards for supercomputers that use thousands of the GPUS to handle massively parallel computations. In 2011, a single TeslaM2090 card could produce up to 665 Gigaflops of computations. The M2090 has 512 "Cuda" cores and GDDR5 memory cards. Transferring heat off the cards is a major design consideration and the cards come complete with liquid-cooled heat sinks. The cards support code written in common languages including C++, FORTRAN, Java, and OpenCL. The M2090 can be plugged into relatively standard computers through an arrangement with HP. Nvidia also sells plug-in modules for supercomputers, including those from Cray Research.

Adapted from Jonathan Angel, "Nvidia Taps GPUs for 'World's Fastest' Parallel Processing," WindowsForDevices.com, May 17, 2011.

by an add-in component for the browser because standards are still evolving. To add more interactivity, browsers also have an internal programming language (JavaScript). Developers can include program code that gives detailed instructions to the browser and reacts to changes users make. For example, when users move the cursor, the code can highlight an object on the browser. Browser code is also used to check user data. This code runs entirely on the local machine, but can send data in batches to the Web server.

The beauty of the browser approach is that it standardizes the way data is displayed, so that everyone is free to choose any hardware and software platform they prefer. Since browsers are relatively easy to implement and do not require huge amounts of hardware, they can be built into smaller, portable devices. Combined with the wireless Internet possibilities, these new devices have the ability to change the business world.

As technology and the Internet become more important in our lives and businesses, portability becomes increasingly critical. Even the portability offered by laptops is useful. For example, you might need to pull up sales data in a meeting or take some work home with you. In other cases, even more portability is needed. Tablet PCs and PDAs provide the ability to access the Internet and your corporate servers as long as you can find a network connection. Wireless connections are available in many locations, but still have limited range. Newer cell phones offer greater connectivity to the Internet from any major city or transportation area in the world. As people demand greater continuous access to the Internet, portable devices become more important. At the same time, the servers that store the data and provide the major processing will also become more important.

What Is a Server?

Do you want to run a Web site? Being a participant in the Internet and running a browser is one thing. Running a Web server is completely different. Establishing an e-business requires that you either run a server or pay someone to run it for you, so you should understand some of the main issues in Web servers.

Reality Bytes: International Notations

Most applications today have the ability to use characters that are not found in the U.S. alphabet. For instance, in France or Mexico, you might need to use an acute mark (é). However, different software packages handle the characters differently, so you might have trouble converting a document from one word processor to another or to a different computer. For example, if a French subsidiary is using WordPerfect and the Canadian headquarters is using Microsoft Word, they can both print reports using the special characters. However, the document might change when the Canadian users attempt to retrieve a French document electronically.

Furthermore, if you work for an international organization, remember that people in different countries write dates differently. For example, 5/10/93 means May 10, 1993, in the United States but would be interpreted as October 5, 1993, in Europe. Most word processors enable you to choose how automatic dates should be displayed.

Numbers are also handled differently in European nations. The use of commas (,) and points (.) is reversed from the U.S. version where commas separate thousands and the decimal point delineates the fractional component. (the number 126,843.57 in the United States should be denoted as 126.843,57 in Europe.)

You also need to be careful with currencies in spreadsheets. When you transfer documents to other languages or fonts, be sure to check any currency symbols. A few systems will automatically change the symbol to the local units (e.g., change $ to £), but unless the numbers are converted by exchange rates, these changes would be incorrect.

Technically, almost any reasonably up-to-date PC can function as a Web server. A Web server is essentially a piece of software that monitors the full-time Internet connection and delivers the requested pages. But to perform e-business tasks, the server also needs to evaluate programmed Web code and interact with a database. In most cases, the primary issue with Web servers is **scalability**, the ability to increase the computing power without changing the application. The goal is to build a server inexpensively enough to make the application profitable, yet capable of expanding to handle increased demands of the future.

In terms of hardware, the primary characteristics that you want in a Web server are (1) scalability, (2) easy backup, and (3) easy maintenance. One solution to all of these problems is splitting the major computer components into separate pieces. For example, server farms use multiple small computers instead of one large machine. A storage area network (SAN) can be built using fiber channel connections to a set of external disk drives.

High-end servers have built-in backups for all critical components. For example, they have dual power supplies, network cards, and hot-swappable disk drives in a RAID configuration. If a power-supply or disk drive fails, the other copy automatically picks up the load. In most cases, the failed component can be replaced without turning off the computer (hot-swapped). More sophisticated servers can be built into server farms that contain multiple computers that distribute the computing load and have access to the same databases. If one computer fails, the others automatically handle the incoming tasks. More importantly, the system can be scaled up by adding more computers.

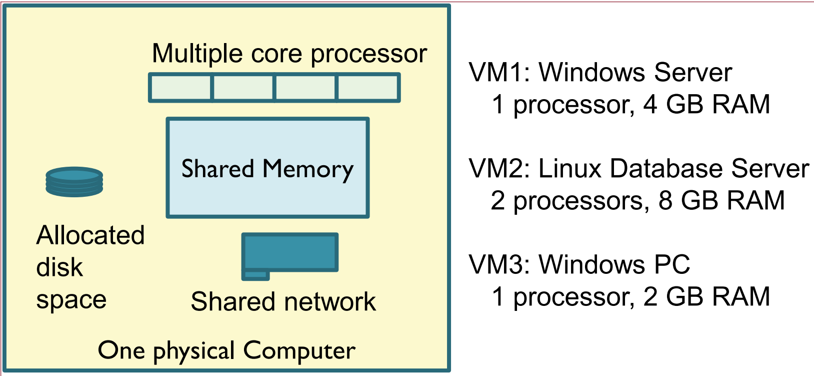


Figure 2.24

Virtual machine. One set of computer hardware is configured to run multiple, independent operating systems. Particularly useful for servers, the goal is to allocate the hardware to the tasks that are busy.

Virtual Machines

With multiple-core processors and tons of memory available, it is common practice today to set up computers as virtual machines. A **virtual machine (VM)** is the process of running a separate computer in software on top of one set of hardware. Generally, the process is used to run multiple virtual computers on a single set of hardware. Basically, one physical set of hardware is configured to run multiple operating systems at the same time so it appears to be several separate computers.

Figure 2.24 illustrates the basic concept of a virtual machine. One physical computer is used to host three separate computers. The hosted VMs are often servers, but the technique can also be used for personal computers. The goal is to allocate hardware resources to the VMs that need the additional computing power. The technique can save money, space, and electrical power, by reducing the amount of physical hardware. It is also useful for separating tasks. Some server software can interfere with other tools and it is often easier to run them separately. VMs also make it significantly easier to backup and restore the entire computer. Once the VM is created, it is stored as a software file on the disk drives. If anything goes wrong, the file can be reloaded and the entire VM is recreated immediately—without needing to reinstall the operating system and all of the applications. On personal computers, the VM technique can be used for creating development and test environments. One system could be used for day-to-day work, and another for testing experimental software. If the experimental software causes problems, the entire VM can be deleted with no effects on the production computer.

VMs can be useful, but keep in mind that you usually need separate software licenses for each VM—both the operating system and the application software. If the systems are based on open-source software, or the organization has a site license these costs are minimal.

Application Software

What are the main software applications used in business? The main reason for buying a computer is its application software. Regardless of your job, you will always perform certain tasks. As a manager and decision maker, you first have to gather data (research). Then you analyze the data and determine alternatives (involving calculations). Next you will make decisions and implement them (requiring writing, communication, and organizing resources). Each of these tasks can be supported by computer resources. The trick is to use the appropriate tools for each task. The objective is to use the tools to make you more productive in your job.

The catch is that productivity is a slippery problem in business—especially with respect to computer tools. One measure of productivity involves efficiency: Can you perform tasks faster? A second, more complicated measure of productivity involves effectiveness: Can you make better decisions? Early uses of computers focused on improving efficiency by automating manual tasks. The tools were often justified on the basis of decreased labor costs. Today, managerial uses often focus on effectiveness, which is harder to measure.

An important concept to remember with application software is that it was created by teams of designers and programmers. In the "old" days, when software was custom-written for specific companies and users, users could tell the designers how the software should behave. Today, most companies rely on **commercial off-the-shelf (COTS)** software that is created to support the needs of millions of different users. In creating the software, designers had to make thousands of decisions about what the software should do and how it should appear. Sometimes their final choices might seem strange, and software does not always work the way you might prefer. Some issues can be resolved by customizing the software to your particular situation. Other times, just remember that you acquired the software for a tiny fraction of the price you would have paid for custom software.

Research: Databases

Almost any job involves workers searching for information. This search could involve any of the five basic types of data. Computers have made it substantially easier to find, compare, and retrieve data. Two important strengths of a *database management system (DBMS)* are the ease of sharing data and the ability to search for data by any criteria. In terms of productivity, a DBMS can both make you more efficient and improve your decisions. It improves efficiency by providing easier and faster data retrieval. By providing more complete access to data, a DBMS helps ensure that your decision incorporates all relevant data.

One complication with research is that you must first determine where the information is located. It could be located on your personal computer, the group's networked server, the company's central computers, a computer run by the government, or one purchased from another company. Unless all of these databases are connected, you must first determine which database to search. Chapter 5 focuses on the use of database management systems. Today, along with numbers and text, DBMSs can handle large text files, pictures, sound, and video. DBMSs form the foundation of almost all business applications.

Today, almost all data in a company is stored in a DBMS, and the things that are not stored in the DBMS really should be there. Even data outside the company such as government data and data from suppliers is often stored in a DBMS. Research typically involves finding and retrieving the relevant data from a DBMS.

Analysis: Calculations

Almost everyone performs computations in a job. Spreadsheets were initially created to overcome the limitations of simple calculators. They are useful for com-

Reality Bytes: Keyboards are Faster than Mice

Key	Task
Ctrl-A	Select all
Ctrl-C	Copy
Ctrl-V	Paste
Ctrl-P	Print
Ctrl-S	Save
Ctrl-X	Cut
Ctrl-Z	Undo
Alt	Menu, then number or letter
Alt-Tab	Switch application
Windows-#	Start applications in taskbar
Windows-D	Show desktop (and restore)
Windows-L	Lock the computer
Windows-P	Projector/switch display
Windows-R	Run box
Ctrl-F4	Close document
Alt-F4	Close application
Ctrl-F6	Switch document within application
Shift-Select	Click or arrow, select contigous items
Ctrl-Select	Click, select multiple discrete items

Adapted from Patrick Miller, "Windows Toolkit: 50 Super Software Secrets," *Computerworld*, July 2, 2010.

plex calculations and for creating charts. Most people find spreadsheets useful because their disciplines began with models on paper that used columns and rows of numbers. For instance, most accounting systems and financial models were designed for ledgers in this way. Whenever software mimics the way you already work, it is easier to learn.

Spreadsheets have many additional features. Graphs can be created with a couple of mouse clicks. Most packages enable users to modify the graphs by adding text, arrows, and pictures. Spreadsheets also perform various statistical and mathematical analyses. You can perform basic matrix operations such as multiplication and inversion. Statistics capabilities include multiple regression to examine the relationships among different variables. Linear programming can be used to search for optimum solutions to problems. These additional features are designed to help you make better decisions by providing more powerful decision-evaluation tools.

The problem with spreadsheets is that people use them to store data. It is also too easy to make mistakes on spreadsheets that are difficult to spot. What often happens is that someone develops a spreadsheet to analyze some data, then other people use the spreadsheet and modify the data and formulas. Fairly quickly, there are multiple versions of the spreadsheet, out-of-date data, and errors in the calculations. And managers want to use these to make decisions. Yes, it is possible to improve the way spreadsheets are built, and Chapters 3 and 8 show ways in which spreadsheets can be shared. But, ultimately, spreadsheets are often better used as short-term tools. They are useful if you need to analyze a small set of data or make one-time calculations. Any decision that requires large, changing, data sets, multiple people, and critical analyses should be built as a specific application. Chapter 9 examines some of the more powerful analytical tools available that can be used for complex decisions.

Communication: Writing

The primary gain from word processing is increased efficiency. Word processors improve communication by making it easier to revise text, find writing errors, and produce legible reports. Word processors today also include a spell-checker, a thesaurus, and a grammar-checker. Although they are not the same as having a human editor correct your writing, these are all useful tools for writers. Grammar-checkers use standard measures to estimate the reading difficulty level of your writing. For instance, if you write an employee policy manual, you want to make sure that an average employee can understand it. Most word processors also have outline tools that help you organize your thoughts and rearrange a document, improving the communication.

The proliferation of word processors creates additional advantages. Today, all documents should be electronic. It should be possible to search electronically for existing reports, manuals, and so on.

Communication: Presentation and Graphics

In many cases, the difference between a good report and an outstanding report is the presence and quality of the artwork. Graphs and pictures are used to communicate information and feelings. Charts and graphs are easy to create, store, and modify using graphics software. Even if you are not an artist, you can buy **clip art** that was created by someone else and use it in your reports or charts. By using existing art libraries, you can create reports and presentations in a few hours. In the past, reports and presentations took days or weeks to finish by a staff of artists. By improving the appearance, a well-designed graphic can also improve communication and decision making.

To create or modify your artwork, you need a graphics package and an input device such as a mouse that enables you to draw on the computer screen. Most commercial artists use scanners so they can draw the original on paper and convert it to computer form. The digitized form enables you to make very precise changes, since you can *zoom* into a specific area. Zooming is helpful if you need to force lines to meet exactly or you want to make changes to small items, such as eyelashes on a person.

Although you do not have to be an artist to incorporate artwork into your reports and documents, you do need an element of artistic sensibility. The goal is to use art to enhance your presentation, not clutter it. Knowing what looks good and using restraint are signs of artistic talent. Remember that faster does not always mean better. Use some of the time savings to put more thought into your presentations.

Communication: Voice and Mail

All jobs require communication—with coworkers, managers, and customers or clients. Word processors help with reports and memos, but much of our communication is less formal. Everyone is familiar with answering machines for telephones. Businesses have taken this concept a step further by using voice mail systems. **Voice mail** systems record messages much like an answering machine, but they store the messages in digital form on computers. They usually give the caller control over where the message is sent. Most people in the United States have dealt with systems that direct you to press buttons on the telephone to make choices. Some voice mail systems enable you to send the same message to several people. Some systems also enable you to skip messages or fast-forward to the end. Many are now tied to e-mail systems so your messages can be integrated into a single site. This process also makes it easier for companies to back up files and store data for later use. In particular, **e-discovery** systems can be used to archive all message data for easy search and retrieval during a lawsuit.

Networked computers can be used to send messages directly to other users. These **electronic mail (e-mail)** systems are typically used to send written notices to various people. They can be used to send pictures, facsimiles (faxes), or even voice messages if the computers have sound boards and speakers. **Instant messaging (IM)** is also relatively popular—often in the form of text messages sent by cell phone. It is nice to have several options for communication. The challenge is to choose the appropriate method for each conversation and each person. Some people prefer the immediate response of voice communication, others prefer the asynchronous nature of e-mail, so they can schedule communications around their work.

The basic problem with any communication system is that sooner or later it becomes cluttered with junk mail. One of the advantages of text e-mail is that the recipient can have the computer scan the messages to search for items that are important or interesting. With the appropriate mail filters, junk mail can be discarded automatically. Messages also can be retrieved and stored for future reference or forwarded to other people.

Organizing Resources: Calendars and Schedules

An important task of managers is to organize company resources so that they are used most effectively. An important function is scheduling workers. Schedules involving line workers entail making sure that there are enough employees to get the job done, but no extra employees. Schedules involving managers typically involve meetings and require trade-offs between competing demands for a manager's time. Several software tools are available to improve both types of scheduling and make more efficient use of the human resources.

Most managers spend a considerable amount of time in meetings. In fact, it becomes difficult to keep track of appointments, set up new meetings, and reschedule meetings. The process is even more difficult when some participants are traveling or are based in another city or country. Several software packages store appointments and schedules on electronic calendars. Electronic calendar and scheduling software enables data to be shared with other people. For instance, each person in a department would use the electronic calendar to keep track of his or her personal, departmental, and corporate appointments. To schedule a meeting with departmental members, the manager selects an approximate time, specifies the priority of the meeting, and fills in the participants, location, and subject infor-

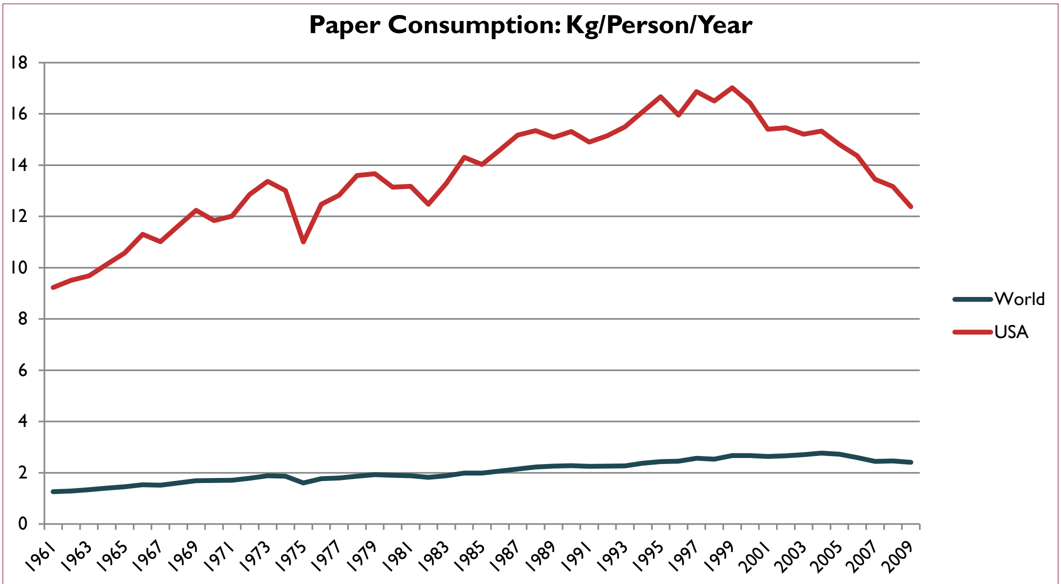


Figure 2.25

Paper (and paperboard) consumption appears to be declining in the U.S. and possibly in the world as well. As video screens improve and people become more adept at handling data online, there should be less need for paper. Raw data: UN Food and Agriculture Organization, http://faostat.fao.org/site/626/DesktopDefault.aspx?PageID=626.

mation. The calendar software then searches each personal calendar for the best time for the meeting. It overrides lower-priority meetings and places the complete notice on each person's calendar in a matter of seconds. Employees have to check their calendars periodically to see whether meetings have been added or changed.

Augmented Reality

Augmented reality is a specialized tool is useful in some business operations. So far, it has minimal uses in management, and the applications are still evolving. Augmented reality consists of overlaying computer-retrieved data on top of images of real-world items. One of the more useful applications was developed several years ago for mechanics working on highly-complex engines, such as jet engines for the military. Workers with special glasses would look at engine components and the computer would display an overlay of the schematics and the part numbers. The part numbers enabled the mechanic to easily order the correct replacement item for worn parts.

Today, people are more familiar with examples of cell phones, where the computer (phone) overlays information on images taken through the phone's camera. The technique combines location data with image recognition and retrieves matching data from online databases. A variation that has been proposed is to add facial recognition software and tag images with people's names. It might be useful for executives who meet hundreds of people a day, enabling them to add a "personal" touch by talking to people by name and retrieving background information. Or, the technology might lead to creepy versions of stalking.

The Paperless Office?

You might think that with increased use of electronic data, there would be less need for paper. For many years, the opposite was true. People tended to waste paper when they knew they could easily reprint a report. However, as display devices have improved, and people have become better at adjusting to electronic screens, it appears that the use of paper is decreasing—at least in some countries. Figure 2.25 uses UN data to show consumption of paper per person per year in the U.S. and the world. The world figures show a slight decline, but the drop for the U.S. is relatively strong over the last decade.

Some issues exist with long-term storage of electronic data. In terms of paper, libraries have stored books for hundreds of years. It is not clear that electronic data can survive even a few decades. First, the data might not physically last that long. Magnetic drives, Tapes, and even CDs and DVDs might lose their data over time. There are also unresolved issues about future compatibility. The hardware and software to read them may disappear in a short time.

Open Software

It is difficult and time consuming to create software. Commercial vendors spend billions of dollars researching customer needs, developing software, and updating and revising the code. For a few decades, major software development has been performed by large corporations that hire thousands of programmers and sell the software for a profit. Microsoft alone spends over $6 billion a year on research and development. On the other hand, the marginal cost of a software product is almost zero. Almost all of the expenses are front-end fixed costs, except for marketing, distribution, and dealing with customers.

In the past few years, led by visionaries such as Richard Stallman with GNU and Linus Torvalds with Linux, a new approach to software development has arisen. Complex programs have been created by using the volunteer talents of thousands of programmers around the world. The result is software specifically developed to be distributed free of charge for anyone to use. The operating system Linux is a popular example, but several application packages exist as well.

As a manager, you will eventually have to answer the question of whether you should use open-source software or continue to rely on commercial packages. The answers are difficult, and discussions are often tinged with religious fervor. Although "free" seems like a good price, how much do you really pay for software? Today, the Windows operating system price is largely embedded in the cost of buying a new computer. On the other hand, more expensive packages such as the Office suite, graphics editor, or database management system can represent large sums of money.

Other issues in open-source software remain unresolved. Often, the open-source packages have minimal support and can be harder to use. Certainly, novices find the Linux/UNIX operating system difficult to learn. Issues about security are unresolved. With thousands of programmers working on millions of lines of code, it might be possible for someone to sneak in a tiny, but nasty, routine. On the other hand, with thousands of people looking through the code, the problem might be caught early. You also need to consider whether the open-source programs will be around for a long period of time. With no real income stream, can they survive? Will the leaders remain in charge? These are important questions to ask any software vendor. But the risks are slightly higher with open-source programs. On the other hand, you do get copies of the source code, so in theory, you could edit and

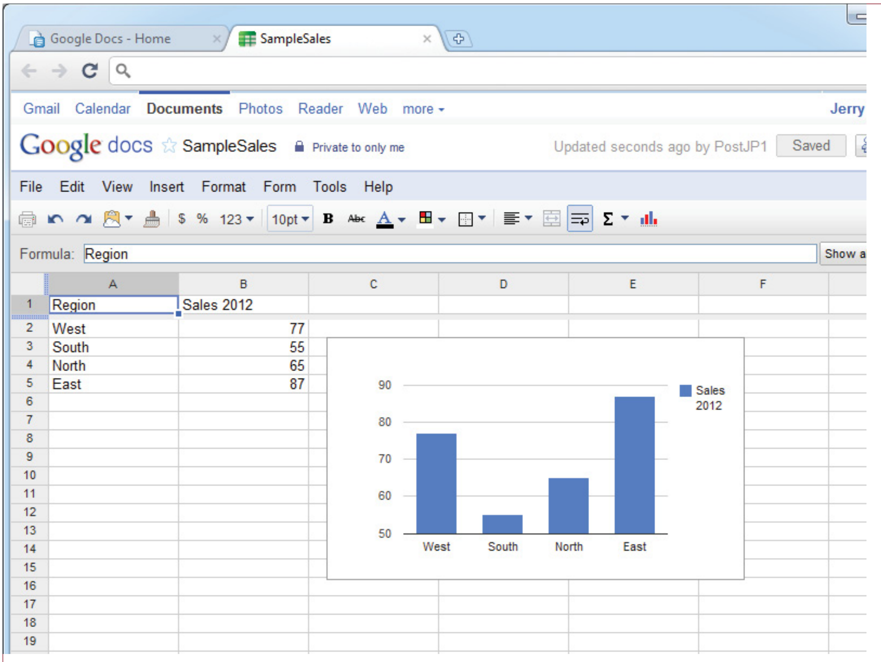


Figure 2.26

Spreadsheet in Google Docs. http://docs.google.com. Google Docs is a cloud service that is free for individuals or $50/user/year for companies that need more services. You can create documents, spreadsheets, presentations, and drawings. The features are limited compared to standard Microsoft Office products but can be created using only Web browsers and are easy to share.

maintain the software indefinitely by yourself. But how many managers or companies have that ability?

In the end, the choice of software comes down to the features and the cost of support. Commercial software is generally supported and updated with the costs covered by the initial purchase price, and sometimes annual license fees. With software such as Microsoft Office, millions of people use the software and generally need minimal training. Open-source software usually has no up-front cost, but often carries annual costs for help, installation, and sometimes updates. Several companies, such as Red Hat and Oracle, make money selling support for open-source software.

Cloud Computing

Is it possible to handle all computing tasks with online services? When computers were first invented, they were large, expensive, and needed large numbers of support personnel. Consequently, all applications and data were run in a single location. Eventually, slow networks were created and display terminals were installed in various locations in a company. These terminals were basically keyboards with simple text displays but they enabled people to work on computer applications from their offices. All of the data and applications remained on the central computer. As minicomputers and personal computers were developed, computer applications and data moved outside the central computer.

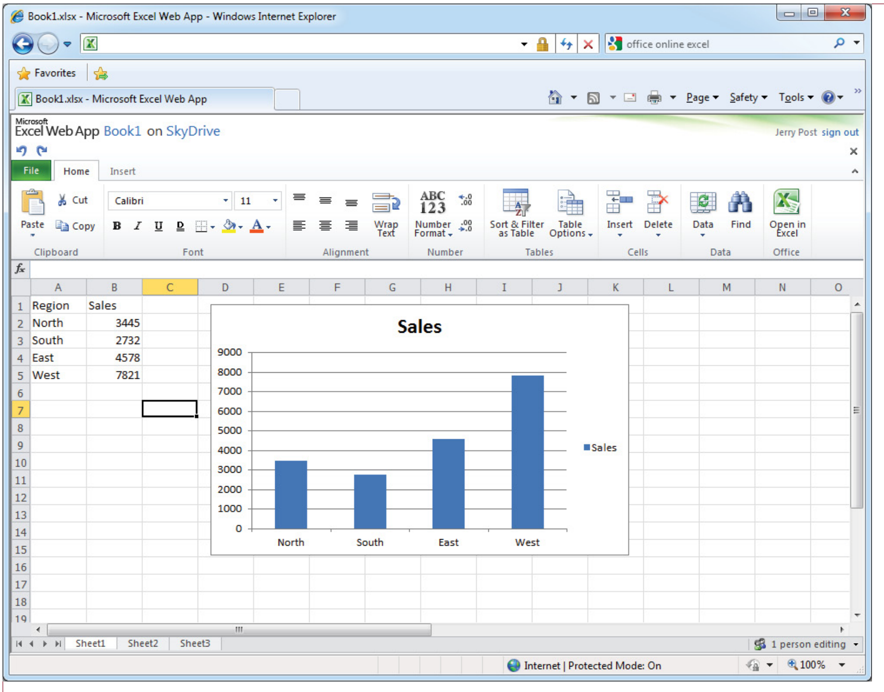


Figure 2.27

Spreadsheet in Microsoft Web Apps. http://office.microsoft.com/en-us/web-apps. The user interface is similar to the standalone Office tools with slightly fewer features. It is easy to upload and download documents to the standalone version and easy to share with other users. Online documents can be created and edited in a browser even on cell phones and tablets.

Gradually, computers got smaller and more powerful. At the same time, network speeds increased dramatically, making it possible to connect handheld devices at high speeds from almost anywhere in the world. These networks are explored in Chapter 3 and the consequences of data management are covered in Chapter 13. But, the key for this chapter is that these capabilities exist now, which provide a method to change the way people use computers. Today, central Web servers can hold all of the data and run applications, while users access them through powerful, but relatively inexpensive portable devices such as cell phones, tablets, and laptops.

Cloud computing is the popular term for storing applications and data on Web servers. The Internet is sometimes referred to as a *cloud* (and drawn that way) because the servers are interconnected and it does not matter where they are located. Often, cloud computing costs are based on variable prices with low or no fixed costs. Sometimes costs are low enough to be supported by advertising revenue so services are provided free to users. Most people are familiar with the social network services (Facebook, YouTube, and Twitter), as well as the search engine services (Google, Bing), and other specific applications such as photo sharing and editing sites (Picasa, Flickr, Photoshop). Thousands of cloud computing applications and sites exist and it seems that more are being created every day.

Think about cell phones and tablets for a second. For the most part, these devices use special-purpose operating systems (often Apple iOS or Google Android). These systems were not designed to run the commonly used business tools such as word processors, spreadsheets, and presentation software. But, do you really want them to run that software? And if they do, where are you going to store all of the data? Instead, it makes more sense to use the devices to display the applications, but leave the applications and data on a Web server. The two main cloud computing sites that provide these services are Google Docs and Microsoft Web Apps. Figure 2.26 and Figure 2.27 show a simple spreadsheet created on the Google and Microsoft services. The Microsoft applications are similar to the standalone Office applications, and it is easy to transfer the documents between the Web and standalone software. Both Google and Microsoft provide free access for individuals—but the advertising can be distracting. Google also sells a version for businesses that integrate a few additional features (such as a shared calendar) and eliminates the advertising for $50 per user per year. With both the Google and Microsoft cloud services, documents can be created and edited using a basic browser, so they can be accessed by relatively simple devices include cell phones and tablets. But, most people would find it tiring to write a long document on a touch-screen keypad, so it would be useful to have a separate keyboard in many cases.

One of the strengths of cloud computing is the ability to share documents with other people. As long as the people sign up on the same service, it is straightforward to give them access to your documents—to view or even edit the document. Generally, the cloud providers handle backups and keep the servers running with high reliability. However, cases exist where documents have been lost. On the other hand, many other companies provide storage space online, so it should be possible to make your own backup copies using multiple storage or e-mail services.

So, is it possible to run most common applications online using cell phones and tablets? Possibly; but it would be tiring to create large documents with a touch-screen keyboard. Most people would find it easier to type using a separate keyboard. Still, the main documents could be created using a laptop or perhaps a tablet, then they will be available for viewing and small edits using a cell phone.

Summary

One of the original purposes of computers was to make it easier to perform basic tasks. Over time, as computers have become more powerful, they have come to support increasingly complex tasks. Today, in addition to increasing efficiency, computers can help you make better decisions. One major change is in the type of data routinely processed. The five major types of data are numbers, text, images, sound, and video. To handle more sophisticated data and more difficult tasks, computer hardware and software have grown increasingly complex.

To choose a computer that best meets your needs, you must evaluate the four basic hardware components: input, processor, output, and secondary storage devices. Each component is measured by slightly different characteristics. Input devices are selected based on the specific task (such as a keyboard for typing, mouse for pointing, or a microphone for voice input). Processors are often selected based on speed and price. Output device quality is appraised by resolution and color capabilities as well as initial and ongoing costs. Secondary storage is evaluated based on speed, capacity, and price.

Application software is the primary source of improved productivity. Packages exist to assist in research, analysis, communication, and organizing resources. Database management systems are used for research and data sharing. Spreadsheets and other analytical tools assist in calculations. Word processors, drawing packages, voice mail, and e-mail are used for communication. Electronic calendars and scheduling software are used to help organize human resources.

With the presence of global high-speed networks, it is now possible to store most applications and data using cloud computing on the Internet. Companies and individuals now have the choice of carrying smaller, simpler display devices that access everything stored on Web servers. Some limitations exist today, and cost, security, and reliability questions remain but this approach can simplify the management of fundamental computing.

A Manager's View

Technology constantly changes. New features are added every day to hardware and software. How do you know which features to buy and which to ignore? The key is to evaluate the features of the main components and to understand how you will use the computer. Given the declining prices of processors, RAM, and secondary storage, it is relatively easy to buy a reasonable computer today for most common business applications. When you get to issues of portability or Web servers, you need to evaluate the choices more carefully.

Key Words

aspect ratio
augmented reality
binary data
bitmap image
byte
cache memory
CD-ROM
clip art
cloud computing
CMYK
commercial off-the-shelf (COTS)
device drivers
dots per inch (dpi)
DVD
e-discovery
electronic mail (e-mail)
ergonomics
grid computing
hardware
high-definition TV (HDTV)
icons
input
instant messaging (IM)
megabytes
milliseconds
motherboard
nanoseconds
operating system (OS)
optical character recognition (OCR)
output
pixels
processor
random access memory (RAM)
redundant array of independent drives (RAID)
resolution
RGB
scalability
software
solid state drive (SSD)
style sheets
synthesizer
templates
Unicode
vector images
virtual machine (VM)
voice mail

Web Site References

Free News Sources	
Associated Press	www.ap.org
CNN	www.cnn.com
ESPN	espn.go.com
Fox News	www.foxnews.com
Internet News	www.internetnews.com
MSNBC	www.msnbc.msn.com
News.com	www.news.com
News Map	newsmap.jp
USA Today	www.usatoday.com
United Press International	www.upi.com
Wired	www.wired.com
ZDNet	www.zdnet.com
Almost any Magazine or Newspaper (some charge)	
Fortune	www.fortune.com
The Economist	www.economist.com
Wall Street Journal	wsj.com
Washington Post	www.washingtonpost.com

Review Questions

1. List and describe the five basic types of data.
2. What are the two main color models? What are the color codes for yellow and green in each of the models?
3. What is lossy data compression and why does it create smaller files?
4. What are the primary hardware components in a computer?
5. How do you know which components to upgrade to improve your computer's performance?
6. Why are style sheets important for large documents and Web sites?
7. Why are SSDs better than traditional hard drives? What are the drawbacks?
8. What are the advantages and drawbacks to using removable disk drives as backup devices?
9. How does the operating system define the way a computer works?
10. How does the use of Web browsers change the way applications operate?
11. How does a virtual machine reduce the costs of large server farms?
12. Briefly describe five tasks you expect to perform in your job as a manager and list the application tool you will use.
13. What will it take for people to adopt a paperless office?

Exercises

1. What are the current best prices of disk drives ($/GB) and RAM ($/GB)? How much does it cost for the fastest processor you can find (not counting exotic supercomputers)?

2. Using a common Web site or retail store, find the price of a mid-level laptop. List the primary specifications. Identify the cost of doubling the amount of RAM on the laptop at the time of purchase. Use a discount Web site to compare the price of purchasing the RAM separately and installing it yourself.

3. Find or create a color chart that identifies and displays at least the 27 primary colors for the RGB color model. Use three levels (0, mid, max) for each of the three colors.

4. Find a high-resolution digital photograph. Using photo editing software, save several copies of the photo in JPEG format with different levels of compression. At what point do you begin to notice the photograph quality degrade? Compare the file sizes as well. Print the photo (a black and white print is fine) and compare the results to the original.

5. What is the highest capacity common SSD available? What is a typical price? How fast is the write speed?

6. How much would it cost to purchase the current release of Microsoft Office for a group of 10 people? How much would it cost to use similar software from an online provider? What are the drawbacks to going with an online provider?

7. Estimate the storage space (number of bytes) required for each of the following items:

   a. A textbook of 700 pages. Create two single-spaced pages with a small PowerPoint drawing on one page. Convert it to PDF format and estimate the size. Compare this number to other sources.
   b. A full-color image from a 7-megapixel camera. Both in raw form (TIFF) and an estimate of the size in high-quality JPEG format.
   c. A 15-minute lecture recorded with the PC audio recorder. Make and save a 30-second recording and use the file size to estimate a 15-minute recording.
   d. If you wanted to store your favorite half-hour television show in digital form, how many bytes of storage would it take? Extra credit: How much space would it take if you remove the commercials? (Hint: Time the commercials.) How much space would it take in HDTV format?
   e. A Unicode document of about three pages of single-spaced text.

8. You have a photo from a 7-megapixel camera at 3072 x 2034 pixels. Your image editing software defaults to 72 pixels per inch, and claims the image is 42.667 x 32 inches. You want to convert to a standard 10-inch wide photo but keep the aspect ratio. You need to find a new resolution that sets the proper dpi and the height.

9. Use research to determine the percent of computers running the Linux operating system.
10. Operating systems define drive space in terms of binary numbers where 1024 = 1 kilobyte, and 1 gigabyte is 1024*1024*1024. But disk drive manufacturers advertise storage space in decimal values, using 1,000 instead of 1,024. If you buy a drive advertised as 200 GB, how many bytes will the operating system recognize on it?
11. Identify at least two competitors to Microsoft Office software and find reviews from people who have used them to comment on their viability for business use.

Technology Toolbox: Speech Recognition

12. Set up speech recognition on your computer and train it. Choose a paragraph of text and dictate it into Word. Do not make corrections to the text as you dictate it. When you have finished, copy the paragraph and make the corrections to the copy. Count the number of mistakes and hand in both paragraphs.
13. Do a quick survey of other students (not in the class) to find out how many have used speech input. Of the ones who have tested it, how many use it on a regular basis? Report the results and comment on the low usage rates.
14. How are the speech recognition systems used in other devices, such as cell phones, different from those used in basic personal computers?

Technology Toolbox: Charts

15. Identify the best chart to use for the following datasets, and give a brief justification for your choice:

    a. Sales by department for the last five years.
    b. Sales by employee for the last month.
    c. Production data for output quality and percent of carbon.
    d. Share of sales to five nations.
    e. Total customer billings by employee for the last 24 months.
16. Find at least two data series from the government (try www.fedstats.gov) and plot them. Briefly explain any patterns or trends.
17. Enter the following sales data into a spreadsheet. Create two charts, one showing total sales over time and one showing the changing percentage sales over time by product type. Briefly comment on the two charts and describe the difference in the information content.

Year	Soft Goods	Hard Goods	Movies
2007	425	632	265
2008	531	789	378
2009	618	865	425
2010	692	897	581
2011	753	933	792
2012	829	989	882

Technology Toolbox: Spreadsheets

18. A company is evaluating the purchase of a machine that costs $50,000. The company will have to pay money each year for maintenance costs. However, the machine will increase profits by several thousand dollars each year. Enter cost and profit data into a spreadsheet. Since the costs and profits occur over time, you have to discount them to a single point in time. Use the net present value (NPV) function to compute the present value of the costs and profits. Initially, assume the discount rate is 4 percent, but build the spreadsheet so managers can change the value easily. Use the Goal Seek tool to find the discount rate at which the investment breaks even. That is, search for the discount rate that sets the computed net value (net profits-net costs) to zero.

Year	Cost	Profit
2008	-50,000	10,000
2009	-2,000	12,000
2010	-2,000	13,000
2011	-2,000	14,000
2012	-5,000	15,000

19. Create a new spreadsheet for a company that has sales of two products (shoes and hats) in two regions (East and West). Put data for the East division in one worksheet and data for the West division in a separate worksheet. Create a third worksheet to display the totals of the two divisions. Chart the changes over time.

Year	Shoes	Hats
2008	456	110
2009	571	98
2010	632	87
2011	771	69
2012	780	120
East		

Year	Shoes	Hats
2008	1024	234
2009	1305	198
2010	1525	178
2011	1598	165
2012	1652	208
West		

Year	East	West	Total
2008			
2009			
2010			
2011			
2012			
Total			

20. You need to evaluate your employees. You have a list of their performance on four tasks—measured in terms of time. The time is the number of minutes they finished behind the fastest person. So smaller numbers represent better performance. Two of the employees were injured at different points and did not complete all of the tasks. Enter the data into a spreadsheet and analyze it by computing the mean and standard deviation for each stage. Then compute four new columns that contain the individual Z-score for each employee in each stage: Zi = (Xi – average)/Std Dev. Compute the average Z-score for each person and rank them. Remember that smaller (negative) numbers are better. Chart the final averages. One extra credit point if you can identify the employees.

Employee	S0	S3	S5	Sf
Basso	0.23	3.05	1.05	7.23
Cruz	0.53	14.85	3.13	31.80
Danielson	0.17	9.92	1.33	11.50
Davis	0.32			
Hincapie	0.13	3.05	0.67	
Leipheimer	0.00	0.00	0.00	0.00
McCartney	0.32	0.07	0.42	0.90
Vandborg	0.30	14.85	3.03	25.30

Teamwork

21. Compare your cell phones. Build an Excel table and compare them based on screen resolution and camera resolution. Indicate if the phone has speech recognition and rate how well it works (on your own phone). What data entry methods are supported? How well does the Web browser work (if it has one)?

22. Each person should research a current version of a tablet computer and write a short list of its strengths and weaknesses. The group should choose one tablet that could be used by business managers, and list the main tasks for which it would be useful.

23. Find a good quality photograph or take one yourself. Have one person save the photograph to at least three copies using different levels of JPEG compression. Hint: Adobe Photoshop gives complete control, but if it is not available, use Microsoft Picture Manager or try an online site such as imageoptimizer.net. Have each team member look at the compressed photos and try to rank them from highest-to-lowest quality. Compare the rankings with the actual order. What do the results tell you about how you should store and display photographs?

24. Have each person on the team find an example of a good chart and a bad chart using newspapers and the Internet. Combine the results from each person into a document so that each person can vote on the best and worst charts.

25. Set up free accounts on one of the online application sites (such as Google). Create a short document to describe a recent movie or television show. Have each person add a couple of lines of comments about the movie. When finished, comment on the benefits and drawbacks of using the online system to write documents versus the traditional method of using separate copies and e-mailing them.

Rolling Thunder Database

26. Using the Export Data form, copy the data to a spreadsheet and create graphs for the following situations. (Choose the type of graph you feel is best suited to present the data.)
    a. Sales by model type.
    b. Sales by month.
    c. Sales by model type for each month.
    d. Sales by state.
    e. Sales by employee by month.
27. Using the existing forms, enter data for a new bicycle order.
28. Find at least two other bicycles (e.g., on the Internet or from a dealer). Create a spreadsheet comparing the features and costs with a similar bicycle built by Rolling Thunder Bicycles.
29. Using the Export Data form, copy the data to a spreadsheet and compute the average profit margin for each type of bicycle for one different year. Comment on any differences that you find.
30. Assume you have to give a presentation to the marketing manager. Create a slide show to compare the sales of each model type for the last two years.

Additional Reading

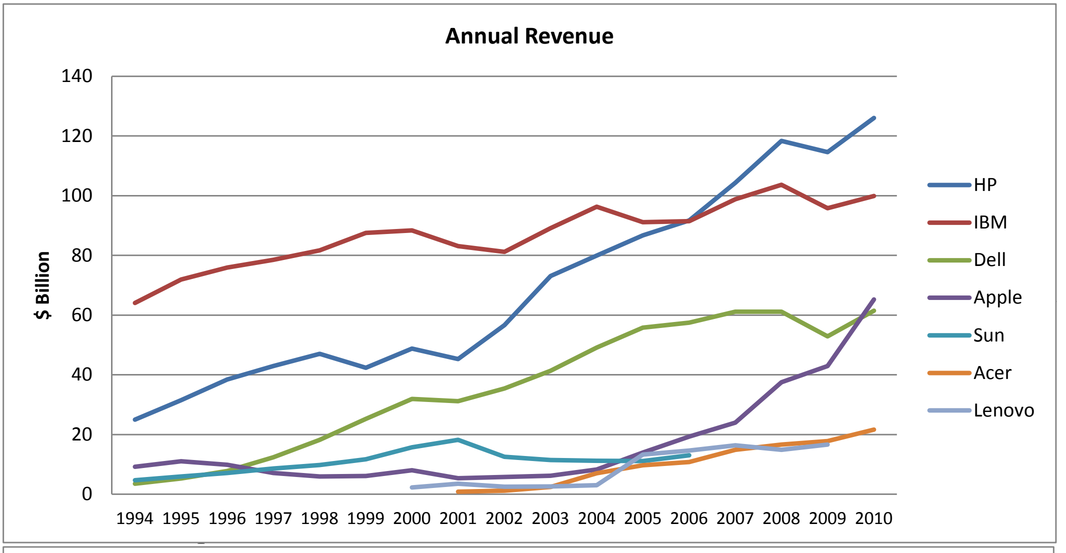
Adams, S., R. Rosemier, and P. Sleeman "Readable Letter Size and Visibility for Overhead Projection Transparencies, *AV Communication Review*, 1965, 412-417. [An early discussion of creating good presentations.]

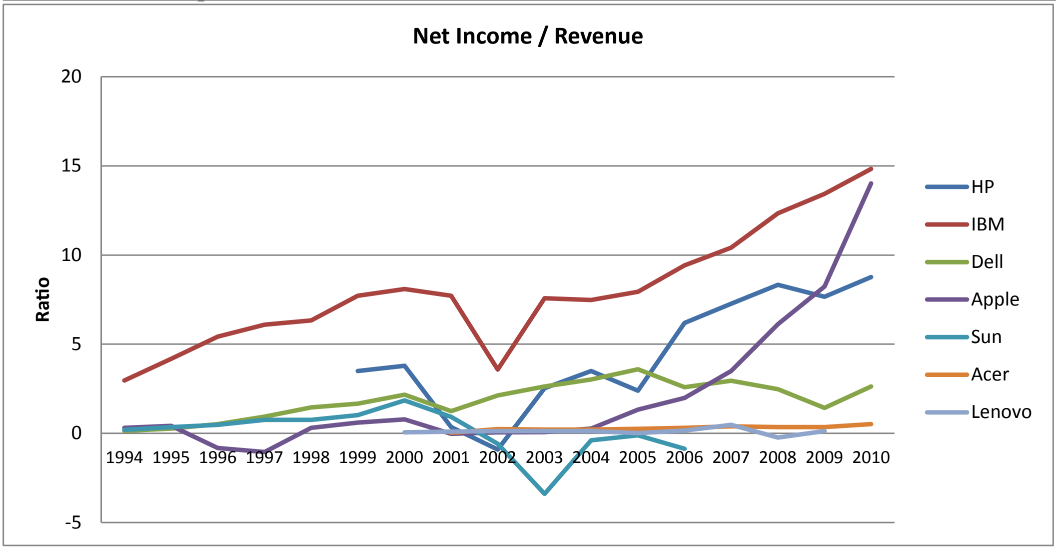
"Science: The Numbers Game," *Time*, February 20, 1988, p 54-58. [Short history of computers.]

Simonds, D. and L. Reynolds, *Computer Presentation of Data in Science: A Do It Yourself Guide*, Boston: Kluwer Academic, 1989. [Ideas for presentations.]

Cases: The Computer Industry

The Industry





A model can become obsolete in a few weeks, and its value can drop in a matter of days. How can a retailer stock items when they depreciate so quickly? Stores can try to forecast demand, but if the economy drops, people may stop buying and the store will be stuck with obsolete computers. Yet selling strictly by mail order means that a manufacturer might miss out on sales to a relatively large market.

These conflicts have caused considerable grief to computer firms over the last few years. Dell, the leading mail-order/Internet vendor, at one time tried retail sales and gave up. Gateway tried to ride the middle line by running its own retail stores. It, too, lost money and closed the stores. Apple has opened retail stores—and been relatively successful. But Apple's target has largely been consumer, not businesses. As HP as increased sales through stores such as Best Buy, Dell has countered by offering a few models through Wal-Mart.

After several years of dismal growth, demand for personal computers increased in 2003 and 2004. PC unit shipments in both the second and third quarters of 2003 were higher than expected. Consumer buying remained strong, and a transition from desktop computers to notebooks has helped to fuel growth in the category. As the average age of the existing machines increased, companies began replacing their computers. Aggressive price competition is a significant factor in stimulating demand. Vendors have reported disappointing PC revenues due to price competition. Competitive pricing pressures continue to drive pricing decisions. In addition, business pressures have not recovered. Consumer demand for notebook computers has also driven demand.

International sales are an increasingly important element in growth for the major computer vendors. Growth in Europe and the Middle East has seen an 18.7 percent year-to-year increase in PC shipments for the third quarter of 2003. This growth was built on the robust sales of portables, which rose 51 percent in consumer and business demand. Aggressive price competition was a significant factor in stimulating demand.

The top firms continue to fight for dominance in the industry, but the weaker firms are attempting to gain ground by consolidating. In 2004, Gateway purchased eMachines. In the process, Gateway fired most of its existing managers and replaced them with managers from eMachines. Gateway eventually filed bankruptcy. In 2006, Dell claimed that it made 1/3 of the PCs sold in the U.S. (2006 Annual Report). By 2009, HP had overtaken Dell as the leading PC manufacturer. For 2009, the worldwide rankings were: 1. Hewlett-Packard, 2. Dell, 3. Acer, 4. Lenovo, 5. Toshiba (Whitney 2010). By 2011, the argument about ranking was whether or not tablets should be counted as PCs. If so, Apple's market share would be significant.

The Consumer Electronics Market

The PC vendors are attracted to the appealing growth projections for consumer electronics markets. For a while, flat-panel TVs helped Dell and Gateway improve profits. By 2007, Gateway/e-Machines had dumped all of its stores and stopped selling televisions. Dell still listed televisions, but the market had been stolen by retailers engaged in vicious price-cutting (including Wal-Mart, Best Buy, and Circuit City).

Apple Computer had success with its retail outlets in 2003. Its stores are located in high-traffic areas, such as upscale malls, near sizable Apple customer bases. Apple's concept has been to create a setting where salespeople can demonstrate some of the new digital camera, digital music, and digital video products, and customers can work with and experience these offerings in the store. The hope is that the consumer will buy not only a new PC but also all the software and peripherals needed for the complete digital solution.

Given the trend toward maturing growth rates in the PC industry, the strategy of broadening product lines to tap higher-growth opportunities appears to be reasonable. However, the margin benefits to the vendors remain in question, given the highly competitive market dynamics of the consumer electronics industry and the uncertainty of growth projections and product life cycles.

In late 2010 and 2011, manufacturers were focused on tablets—led by Apple's success with the iPad. Yet, early tablets were largely consumer devices—capable of displaying movies, retrieving files, playing music, and handling small e-mail messages and Facebook updates. But, with low resolution (typically 1024 x 768) and no keyboards, they were not replacements for full-blown laptops because it was difficult to enter data and create content on them. Continued evolution and features might change these relationships.

Case: Dell

Dell posted rapid sales growth since July 1994, when it discontinued retail channel sales to focus exclusively on its direct business. After entering the market for Windows-based workstations in 1997, the company quickly became the world's leading supplier. As of the first quarter 2003, Dell was the world's largest PC maker, retaking the title from Hewlett Packard Company, which with its May 2002 acquisition of Compaq Computer became Dell's largest rival. Desktop computer systems made up the largest segment (53 percent) of the business. Dell ranked first in the United States and second worldwide in desktop shipments in calendar 2002. At the end of fiscal 2006, Dell had net revenue of about $56 billion. By 2007, Dell was rapidly losing ground to Hewlett-Packard. PC shipments increased by 13.1 percent in the first quarter of 2006 but Dell's sales grew by only 10.2 percent (ZD Net 2006). By the first quarter of 2007, Hewlett-Packard surpassed Dell as the world's largest producer and Dell's worldwide shipments fell by 6.9 percent in the first quarter of 2007 and U.S. shipments fell by 14.4 percent leaving Dell barely in the lead with 26.8 percent of the market compared to HP at 25.5 percent (Darlin 2007). In 2009, HP's share of shipments was 19.7 percent, Dell's was 12.9, and Acer was close behind at 12.7 percent.(Whitney 2010).

The company's higher margin notebooks and portables include the Latitude product lines, for corporate users, and the Inspiron line, for consumers and small businesses. Dell offers services that include professional consulting, custom hardware and software integration, and network installation and support. Manufacturing sites include Austin, Texas; Limerick, Ireland; Penang, Malaysia; and Xiamen, China.

Dell is aggressive in pricing its products. As a direct seller of PCs, Dell benefits because it can pass lower component costs through to customers faster than its rivals. As such, it can lead the competition in price cuts. The company strategy includes the ability to gain market share by leveraging its position as the low-cost producer in the PC industry. Dell's market share gains over the past year reflect the successful implementation of this strategy. This strategy is cramped, however, by the rapid growth in component prices.

In February 2007, Michael Dell, fired Kevin Rollins who had been CEO since 2004, and Mr. Dell took the job back in an effort to turnaround the company. Dell's sales model was good at holding down costs, but sales were shifting. Dell had been focused on business and educational customers who were more than willing to purchase direct from Dell. But sales to consumers surpassed sales to businesses and it turns out that individuals preferred to buy computers from retailers—notably Best Buy, Circuit City, CompUSA, and Office Depot. Markets that H-P had locked up several years earlier (Lawton and Lublin 2007). Mr. Dell continued the takeover by removing or replacing a third of its executive board.

In May 2007, Dell announced a deal with Wal-Mart to sell two desktop models directly to consumers. Bob Pearson, Dell spokesman, said "our customers are asking us for additional ways to purchase our products and we plan on delivering on a global level…Today's announcement with Wal-Mart represents our first step. Stay tuned." (Lawton 2007). Perhaps Dell will recognize that two desktops are not going to change the world, and that many people prefer to buy laptops. But, if you put Dell laptops side-by-side with those from H-P, Sony, Apple, and IBM, will consumers reject them because of a lack of style and engineering?

Keys to Success

Much of Dell's success has been credited to the built-to-order model. Nothing is manufactured until someone buys it. This reduces inventory holding time to three to five days. Dell also applies this just-in-time approach to its marketing efforts. Advertising dollars and resources are focused on the segments that are growing the most. For example, the fourth quarter is always focused on the holiday gift season for consumers. Quarters 2 and 3 are focused on the public sector when schools and the government begin their buying cycles.

While Dell has always sold to the education market, in 1996 the sector became more interesting, thanks to the federal government's E-Rates program that provided from \$2.5 billion to \$3 billion per year to subsidize schools' technology budgets. Apple had previously addressed this market by engaging in "emotional marketing," pitching warm and fuzzy computing to teachers in the hope that they would lobby their schools. In contrast, Dell had realized that computers in the schools had moved from freestanding desktop tools to nodes in an increasingly complex web of technology that included wireless networks, handheld devices, software, and servers. While Apple advertised personal creativity, Dell marketed standardization and commoditization. Dell did not go to its education buyers and say, "We'll sell you desktops and laptops." They offered solutions including education software, packages, and IT services. They addressed storage and the leverage of the existing technology. This approach proved to be more compelling for people with limited budgets and no resources or staff.

Perhaps Dell's most important weapon was its huge customer database, the result of Dell's sales model. This provides a direct relationship with the customer. Since it sells directly, Dell can get immediate feedback from customers before, during, and after the sales process. Dell courts such feedback, maintaining a Platinum Council of buyers to offer their insight at the executive level, and also inviting customers to work with product development teams in a direct feedback loop.

Due to tight supply chain management, Dell's made-to-order model is also a financial gold mine. Dell orders and receives components as they are needed to build a machine. The computer is shipped within a few days, and the customer is charged. But Dell does not have to pay the suppliers until 30 days later. So Dell earns interest on the revenue for a couple of weeks before it pays suppliers.

Database Applications to Better Service Customers

Valerie Hausladen knew that she could get Dell's customer database to work harder. "I used to be more of a traditional marketing person," she says. "But I learned that unless I could measure and show ROI on marketing, my budget kept getting cut. I realized at Dell, you have to be able to show results" (Kuchinskas 2003). Hausladen set up a pilot program to test whether better customer relationships could be established in the interactive channel. Smaller Dell accounts were initially targeted in three areas: health care, K-12 schools, and colleges and universities.

Dell divides its accounts into the three categories of acquisition, development, or retention. Development accounts are those that the company thinks could grow, or that are not spending all their budgets on Dell products. The tactical goal of the campaign was to get the name of one buying decision maker for each account. The strategic goal was "to become more actionable on how the company served customers with right information at the right time." The implementation goal was to send laptop information to customers who were interested in laptops and server info to server buyers.

Dell's database group went to work. They analyzed Dell's customer list to establish benchmarks. To find out if Dell knew a decision maker at an organization, they analyzed job titles, asked salespeople, and even called the customer to ask. They also began outreach via e-mail and direct mail, renting mailing lists and building and refining the Dell customer database through opt-in methods.

To implement the program, Web portals were built for each of the customer verticals, offering tools and information to aid them in their technology decisions. This was aided by the fact that the three Knowledge Centers—for K-12, institutions of higher education, and government purchasers—were similar in their application. The visual identity and content for the Web pages were crafted to serve as a "virtual account executive" for each market.

The direct mail campaign focused on two goals. First was the desire to alert customers to deals and sell more products. Second was the effort to improve information in the customer database and turn names into relationships. When customers registered on the Knowledge Center sites to read content or request e-newsletters, they also selected products they were interested in from a list. The next time Dell communicated with them, it focused on the items they had checked. The Dell team set up a control group to measure the effects of their marketing and define subsequent benchmarks. Dell began to see results from this database marketing effort in 2002. The short-term gains included the maximization of tactical things like response rates. This included the establishment of 5,000 new accounts in eight months. The Web interface lets the marketers compare different campaigns, different media, and calculate the current ROI. Three years into the program, Dell's information-rich database contains at least one key decision maker for each account. The goal is to expand this list to the names of five key decision makers for each location in the database.

Dell addresses the budget-conscious public sector market by talking to them about getting what they need, supporting them, and saving them money. In direct mail, e-mails, and on the Web, it uses a straightforward style and packs its communications with information. The postcards are not fancy. They include a couple of generic hardware close-ups and text. They follow a simple formula: one close-up of the product, another that shows the entire case, a photo of smiling customers, and lots of text, with prices prominently featured.

All this leads back to the Knowledge Center Web page, where Dell is building a deep resource that offers quick links to shopping, customer service, and technical support backed by articles that can help Dell's customers evaluate, plan, and use technology more effectively. They are also integrated with more offers, sweepstakes, and discounts. Every time a customer clicks within a newsletter, navigates around a Knowledge Center, or responds to a postcard electronically or via a call center, the choices are recorded in Dell's customer database. Over time, the Knowledge Center begins to appear differently from the one encountered by another education decision maker. This system results in a more interesting interaction with Dell each time the customer comes to the Web page.

Dell has Rerouted its US Support Calls to the United States

In November 2003, Dell rerouted calls from its U.S.-based users to a U.S.-based call center instead of to its facility in India. Some customers had complained about the quality of the help they had received from the offshore center. Support operations for Dell's Optiplex line of desktop PCs and its Latitude notebooks were moved back to facilities in Texas, Idaho, and Tennessee.

Ned May, an analyst at the market research firm IDC, said he had heard criticisms from corporate IT managers about the support they were getting from Dell's call center in Bangalore, India. Barry French, a Dell spokesman, said a portion of the calls from U.S. PC users would still go to India, where support has been handled since mid-2001. He indicated that Dell may shift all of the support back offshore at some point. "We are increasing the number of people we have providing support in India," he said. "Dell has a number of call centers around the world, and we will continue to optimize those to provide the best customer experience" (Brewin 2003).

In 2011, Dell and HP both began buying companies to expand offerings for business servers. Dell paid $800 million for Compellent, which provides data tiering. A network attached storage box contains multiple levels of drives—some fast and expensive (flash drives), and some slower but large and cheap (SATA). The software automatically moves lesser-used data to the cheaper drives (Mearian 2011).

Also following HP, in 2009 Dell purchased Perot Systems—one of the large outsourcing vendors—which happens to be located in Texas (Niccolai 2011). As part of its new services unit, Dell is focusing on providing private cloud-based computing to business users. Dell partnered with SAP and several other companies to be able to host SAP applications on its servers (Kanaracus 2011). With its traditional emphasis on business sales, Dell has been building server farms to provide private cloud-computing to businesses that need high-speed facilities. Dell also expanded its server offerings including blade servers with up to 96 processor cores. Dell's moves into enterprise servers and cloud-based hosting helped provide large increases to net income in 2011.

Questions

1. Is the pace of technological change slowing? Can a business wait longer now to refresh computers?
2. How is information technology critical to Dell's success?
3. What is the current status of Dell's recycling program and is it successful?
4. Why is Dell expanding into consumer electronics and corporate networking products?
5. Is there a limit to the number of computers Dell can sell through its current methods? Should it reconsider retail sales?

Case: Gateway and Acer

Gateway was the third largest manufacturer of PCs in the United States, but it struggled for several years. It tried selling computers, and plasma TVs, through standalone stores, but struggled to make profits. Gateway gained market share in the PC industry until the second half of 2000. Since that time, its rapid growth has reversed. In 2002, Gateway estimated its market share to be 6 percent, but the company still believed it had a strong presence in the U.S. consumer market. In early 2001, management reviewed its operations and discontinued unprofitable revenue streams beginning in the second quarter of 2001 with roughly $200 million per quarter. In the third quarter 2001, it exited its international operations. In March 2003, management planned to save $400 million annually from workforce cuts, cost programs, and a reduction in the number of its stores. In March 2007, the former CFO and controller of Gateway were found guilty of manipulating earnings and revenue statements. Gateway also acquired a new CEO in late 2005. Sales in 2006 were just shy of $4 billion with a net income of about $9 million. But the company has to grow profits considerably to overcome its half-billion dollar loss in 2004. Slightly over half the sales value was for desktop computers. Most of sales ($2.7 billion) were through retail outlets (2006 Annual Report).

In the beginning, Gateway focused on providing high-end personal computers at relatively low prices. The company led the industry consolidation through the 1990s and dominated PC sales for a time. Based in South Dakota, the company featured a cow motif as a means to create a brand identity. Eventually, headquarters was moved to San Diego. In 1997, Gateway introduced an innovative extension of its traditional business model. Instead of relying on developing customers solely through the Internet, Gateway opened 37 Gateway Country stores in which customers could test-drive PCs. One of the goals was to expand sales of consumer electronics goods such as printers, cameras, and eventually plasma televisions. After several years of expansion, the company began closing certain stores. As of December 31, 2002, Gateway had 272 retail stores in the United States, down from 327 at the end of 2000. In the first quarter of 2003, the company closed another 80 stores. In 2004, Gateway acquired eMachines largely in exchange for stock. Ted Waitt, founder and chairman, quickly replaced Gateway management with eMachines managers. In April 2004, the new management shut down all of the remaining Gateway retail stores (Zimmerman 2004).

In 1997, Gateway also launched its Internet service. In October 1999, the company announced a strategic alliance with America Online, calling for Gateway to package AOL service into all its computers. AOL was to invest $800 million in Gateway over two years, including $150 million in AOL stock. In December 2001, Gateway extinguished its convertible note to AOL through the issuance of 50,000 shares of Series C redeemable convertible preferred stock. This resulted in an extraordinary gain of $4.3 million, net of tax.

Realizing the price competitiveness in technology, Gateway was among the first PC vendors to shift its focus to "beyond the box revenues." These revenues incorporate the sales of software and peripherals, Internet access, financing, and warranty and training revenue. In 2002, these sales were $692 million, down from $1.2 billion in 2001 and $1.9 billion in 2000. These sales have wide margins. Several categories offer recurring revenue streams. Gateway reported a net loss of $0.95 in 2002. By 2006, revenue from non-PC sales had dropped to about $650 million.

The merger with eMachines appeared to represent a refocusing on the "value" end of the computer spectrum. Originally, eMachines succeeded by building standard computers in China and beating the cost of equivalent Hewlett-Packard machines by $150. As PCs become a commodity industry, people are less interested in the raw technology. Instead, certain features become important, such as more memory or larger disk drives. John Hui, the owner of eMachines, explained that "they created what we called a 'value formula' that Wayne [Inouye] developed at Best Buy. They attach value to every single component of a PC. They can at any time tell you if you use, let's say, a DVD RW versus a CD ROM how much more the consumer is willing to pay. Now that has nothing to do with the cost. Because (it's) the value that the consumer will attach to every single component. For example, how much is the consumer willing to pay for a 512MB system versus a 256? They can attach value to it, because the consumer knows they can easily buy the memory and stick it in themselves. But the memory prices go up and down every day. So they have a certain perceived value. And when that perceived value is high and the cost is low, that's when eMachines would put those components in there." Inouye became CEO of Gateway after the merger (Zimmerman 2004). By August 2007, Gateway had failed and the name was purchased by Acer (Lemon and Nystedt 2007). Acer, a Taiwan-based manufacturer quickly became one of the leading PC manufacturers. A large part of the growth came through selling low-priced netbooks—small laptops designed for basic Web browsing and e-mail tasks.

By 2011, Acer was being squeezed on the low end by tablets, particularly the Apple iPad. People chose to purchase the small, lightweight tablets instead of buying the small netbooks that had increased Acer's growth. Later in 2011, Acer decided to re-enter the server market. Servers often have higher profit margins, but reliability is critical and manufacturers build in duplication in case components die (Thibodeau 2011). Acer plans to use third-party makers to put the servers together. Todd Mottershead, senior manager for servers and storage noted that "I want to make sure that we can build very, very quickly and deliver much faster than everyone else." One interesting, but unanswered, question is whether Acer will go with a proprietary server format. In late 2010, Facebook began pressuring vendors to develop a generic server. The company created design specifications down to the cabinet and motherboard layouts. Up to this point, server manufacturers built incompatible systems. Although they used off-the-shelf components for drives, RAM, and processors, it generally was not possible to even transfer a motherboard from one case to another. Standardization will make it easier to substitute parts; which ultimately increases competition and drives down prices. But it is not clear yet if vendors will be willing to build to the standards.

Questions

1. Why did the Gateway stores fail?
2. Can smaller vendors like Acer and Toshiba survive?
3. Are tablets PCs and will they replace laptops?

Case: Sun

Sun was the No. 3 manufacturer in server technology, with 13.5 percent of the market, and its market share and revenue were dropping in the early 2000s. Sun focused on the UNIX market where it was the No. 1 vendor. Founded in 1982, Sun Microsystems invented the workstation. It relied on the concept that the network is the computer. Sun was a leading supplier of networked computing products, including workstations, servers and storage products that primarily used Sun's own

Scaleable Processor Architecture (SPARC) microprocessors and its Solaris software. Computer systems accounted for 55 percent of net revenues in 2003, network storage products 14 percent, support services 25 percent, and professional services 7 percent.

Sun's workstations were primarily used for engineering applications (CAD/CAM), desktop publishing, software development, and other applications that need a moderate amount of computing power and high-quality graphics capabilities. In terms of computing power, workstations fall between PCs and mid-range computers. UNIX has been the most common operating system for workstations, but Microsoft's Windows has posed a formidable challenge. Sun's workstations ranged from low-cost UltraSPARC-based workstations to high-end, multiprocessor color graphics systems. Sun servers can be used for file sharing, letting users access data distributed across multiple storage devices and networks, or as computer resources, to distribute computer-intensive applications across multiple processors.

In June 2000, Sun shifted its focus to include storage, launching its StorEdge T3 line, as well as software and services to enhance its storage solution offerings. In 2002, Sun introduced Solaris 9, the latest upgrade of its popular UNIX operating system. Its features include identity management and enhanced security and manageability.

Sun has concentrated on software development as well. It invented the Java object-oriented programming language. Java has attracted significant interest in the software development industry because of its portability; software created in Java can run on any type of system. As a result, it is a popular tool for designing software for distribution over the Internet.

Sales at Sun were weak through the early 2000s as customers realized that Intel-based personal computers could perform as effectively as workstations and midrange servers, at a substantially lower upfront cost. In 2004, Sun received $1.6 billion in a settlement with Microsoft over the use of Java. Yet Sun lost $0.75 billion in just one quarter of that year and was forced to lay off 9 percent of its workforce. In 2004, Sun began selling Intel- and AMD-based workstations that could run the Windows and Linux operating systems. But Sun could not compete in the low-end and midrange markets. Sun's 2006 Annual Report shows increasing sales revenue (to $13 billion in 2006), but it sustained net losses from at least 2002-2006. A huge portion (15 percent) of Sun's sales were to GE. Demand for high-end data center servers declined in 2006 in favor of smaller systems—where Sun faces greater competition.

For years, Sun had relied on proprietary processors. By 2006, most production had shifted to high-end processors available from Intel and AMD. The company also expanded into the data storage market, buying StorageTek in 2005, in an attempt to provide a market for storage applications. In 2006, revenue from data management products and support services exceeded revenue from computer systems products. On the high-end, Sun lost out to IBM and Cray Research in a bid to provide supercomputers for the U.S. government. According to Sun's 2006 Annual Report, most HRM and IT functions for the company have been outsourced and are provided by other companies.

In 2009, Oracle, the database vendor, paid $7.4 billion to acquire Sun (Clark and Worthen 2009). The general presumption was that Oracle wanted to gain control over Java, which is an important element in developing systems in the Oracle database. Sun still produces some servers, but the workstation market had largely disappeared by 2011. Sun still markets the Sun Ray system which is one of the original thin-client approaches. All of the computing work is handled on a server and users interact with basic graphics terminals and a keyboard. The primary objective is to keep the software and data in a central location to make it easier to install and maintain. The problem is that the client terminals cost almost as much money as a complete PC and the servers are expensive. The original goal was to reduce management costs by centralizing the software and data, but with network-based controls available today, there is little reason to spend the extra amount of money on the server. In any case, Sun was struggling for years to sell servers. The business continued to decline due to uncertainty after the purchase by Oracle. But, in the first quarter of 2011, Sun saw an increase in the sales of servers hitting $773 million in the first quarter (Niccolai 2011).

Questions

1. Can Sun survive? How will it compete against Linux and generic PCs?
2. Since much of the world has accepted Java as a Web-based programming language, can Sun make any money from it?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 3

Networks and Telecommunications

Chapter Outline

What You Will Learn in This Chapter

- What is the value of a single computer?
- Why are computer networks so important in today's businesses?
- What components do you need to install to create a network?
- How can multiple users share a single network?
- How is it possible that you can connect your computer to a network at the office, at home, or while on the road, even overseas?
- What is the Internet, how is it controlled, and how does it work?
- Are personal computers necessary anymore?
- What problems are you likely to encounter if you need to connect to a supplier in a different country?

Owens & Minor

How do suppliers connect to customers? Owens & Minor sells thousands of products to hospitals. It is one of three large companies in the market, competing with Cardinal Health (which owns the system built by American Hospital Supply). Like other wholesalers, Owens & Minor exists in a highly competitive environment with low margins. Whether you call it logistics or supply chain management, buyers continually search for ways to reduce their purchasing costs. Companies like Owens & Minor use information technology to reduce inventories throughout the purchasing system. By building links with customers and suppliers, Owens & Minor can immediately react to changes in demand and plan the most efficient method to deliver supplies.

Introduction

What is the value of a single computer? This question almost sounds like the old Buddhist Zen koan: What is the sound of one hand clapping? You do not need to debate the complexities of Zen to understand that the value of computers is multiplied by connecting them and sharing information. Today, many applications exist only on the network—they are built to use servers to store and process data and they are accessed across the Web from any location in the world. And communication ranging from text, to voice calls, to video conferencing has largely moved to Internet-based formats.

As shown in Figure 3.1, networks are useful on two levels. Internal company networks are used for teamwork and sharing data; the Internet connects you to external organizations, including suppliers, customers, and service providers. Actually, you use many other networks in your daily life, including cell phones, television, and even electricity. Today, almost everything you do in business relies on computer data networks. You use them for communication, sharing data, team work and collaboration, and simpler things such as backing up your data and printing.

Even though you will probably not be responsible for creating or maintaining a network, knowledge of the underlying technologies makes it easier to understand some of the problems that can arise, and helps you see how the technology is likely to change in the future so you can be prepared. Network technologies have experienced some of the most rapid changes in the past few years, and new technologies are being deployed now. You need to plan ahead so you can create new organizations and new methods of handling work.

The Internet has changed many aspects of daily life, and has the capability of fostering even more changes. To understand these opportunities and recognize the challenges that need to be overcome, you need to learn a little about how the Internet is designed and how it works. The Internet is an interesting organization because it is governed purely by committees and individuals and works because of standards. These organizations face difficult questions and the answers will dramatically influence your life and the role of businesses in the years to come. If nothing else, as an informed citizen, you need to be aware of these discussions. Many times the decisions hinge on social, economic, and political issues instead of purely technical ideas.

Trends

In many ways, the communication systems available today began with the telephone. Originally, sounds were converted into analog electrical signals, and calls were connected through physical switches. As computer technology evolved, it became possible to convert everything into digital data and the computerized switches simply transfer digital packets to a desired destination.

A key aspect of communication systems is that some connection medium is required to transmit data. Most homes have two major connections: telephone and TV cable. The phone and cable companies have been expanding their services by providing better and faster connections to houses. Thanks to the long-distance phone companies, hundreds of thousands of miles of national and international fiber optic cable connect cities and nations around the world. These backbone connections carry almost all of the Internet data, voice, and video connections.

But, the biggest trend in the past few years has been the switch to cellular phones including smart phones used as computers to access the Internet. People are increasingly giving up wired connections in favor of mobile connections that operate over radio waves. As nations move to provide more bandwidth for cellular service, data transmission capabilities for mobile phones is approaching the speeds available for fixed-line connections.

As connections and usage have grown, so have the applications and data available. Consequently, it is increasingly important to be able to connect to the Internet from anywhere at any time. Which leads to an increasing cycle: As connection capabilities improve more applications and data become available, which means connection capabilities need to improve even further, which leads to new applications, and so on.

The global economy makes life more interesting—particularly in terms of networks. Sharing data, or even using cell phones, across international borders raises many complications. Because technology continually changes, nations implement the technology at different points in time. Compatibility across borders is an even greater challenge when nations have differing goals and income levels. As managers, you need to be aware of some of the issues, both to communicate and to travel.

The objective of a network is to connect computers transparently, so that the users do not know the network exists. The network provides access to data on central computers, departmental computers, and sometimes other workers' personal computers. Networks can create shared access to fax machines, modems, printers, scanners, and other specialized hardware. To the user, it does not matter where these devices are located. The network makes them work the same as if they were on any desktop. The Internet expands these capabilities across the world. Wireless makes the services available to you wherever you travel in major cities.

Network Functions

Why are computer networks so important in today's businesses? Most companies did not seriously begin installing networks until the early 1990s. The Internet expanded into the commercial world in the mid to late 1990s.

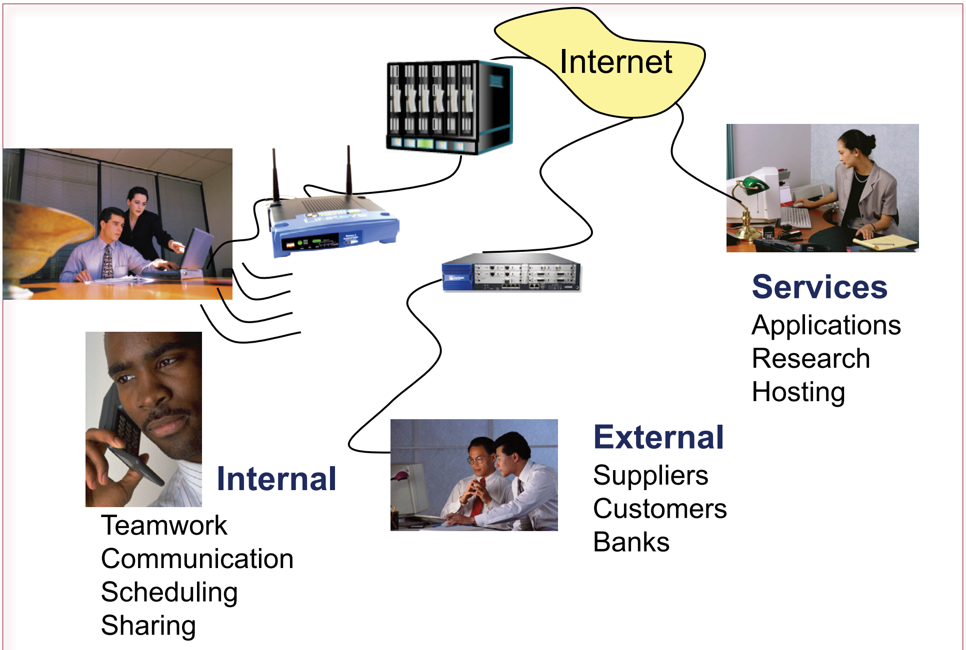


Figure 3.1

Networks. Managing an organization requires communication and teamwork. Networks facilitate teamwork and create opportunities for new organizational structures. The Internet makes it easy to connect to customers and suppliers and access new services and Web-based applications.

Perhaps the better question is: Why did it take so long? The answer: cost. Think about that time frame for a minute. The digital world as you know it is only about 15 years old, and it has already had a huge impact on business and society. But, the world is still only at the beginning of the network evolution. New opportunities in both communications and applications will continue to arise. And you will face new questions about choosing technologies and applications. To understand the value of networks, you need to look at the business applications and new procedures that have been created with networks. Then, you can start thinking about the future networks and new applications—particularly wireless and mobile applications.

Sharing Data

Sharing data is one of the most obvious uses of networks and it can make profound changes in the way an organization works. Managers can see customer and marketing data immediately as it is collected. Employees in one department can easily share data with other departments. A network facilitates the use of teams. In particular, it enables informal teams to spring up throughout the company to solve problems as they arise. Instead of waiting for a higher-level manager to appoint a team, employees can use the network to ask questions, notify others involved, and find in-house experts. A **local area network (LAN)** is commonly used to connect computers and share data within a company. A LAN uses the same technologies as any other type of network, but is recognized separately because all of the compo-

Figure 3.2

Network for transaction processing. Networks are often used to collect data in a central database. From there, the data can be queried and analyzed by managers. E-commerce sales represent transactions across the Internet.

nents of the network are owned by your company or organization (or household). Since you own everything, you get to make all of the decisions, and you do not have to pay anyone else to transmit the data.

Transactions

One of the most important reasons for connecting computers is the ability to share data. **Point of sale (POS)** systems were some of the first networks installed in businesses.

Consider a retail store with five checkout registers. Each register is actually a computer. If these computers are not connected, it is difficult to compute the daily sales for the store. At the end of the day, someone would have to manually collect the data from each computer and enter it into another computer. Also, imagine what would happen if a customer asked a clerk to determine whether a product was sold out. The clerk would have to check with each of the other clerks or perhaps call the storeroom.

As shown in Figure 3.2, with e-commerce transactions can take place across a wider network, with the Internet as the network and customer browsers as the client computers. The product data and sales transactions are stored in the central database connected to the Internet. Using a central database provides inventory data to customers. When a customer asks whether an item is in stock, the Web site can provide the answer. Managers can get daily sales figures from any location with a Web browser and an Internet connection. Payments and bills can also be handled directly online. The same diagram can be used for traditional in-house

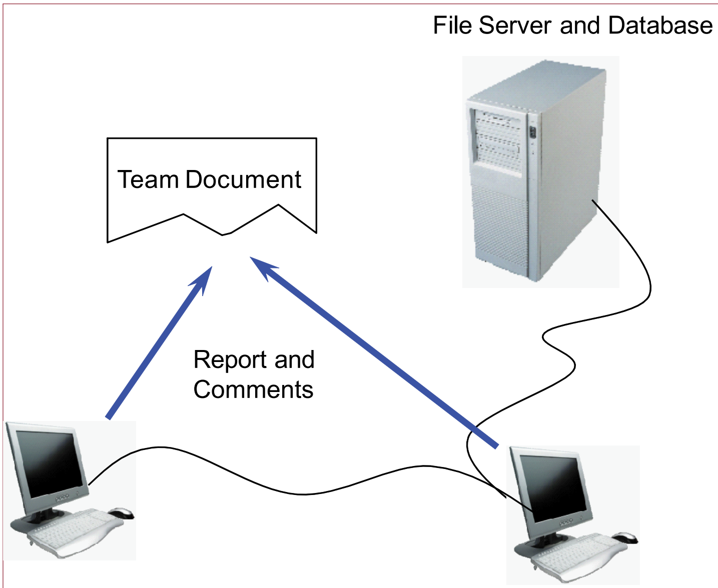


Figure 3.3

Network for decisions and collaboration. The file server holds basic data and software tools. Managers retrieve data and create reports. The reports can be shared with other managers. With collaborative software, revisions are automatically tracked and combined to form the final document.

POS systems by replacing the Internet with a simple LAN. The main point is that a central server holds all of the data and handles the actual transactions.

Decisions and Collaboration

Many types of data need to be shared in a company. But beyond simple data sharing, people often work on teams. Teamwork entails developing reports together. It requires searching for data, editing documents, and sharing comments. A portion of a network for making decisions and sharing work with team members is illustrated in Figure 3.3. Centralized data and shared documents ensure that everyone has the same version of the data and the same final documents.

In any job, it is rare for one person to work alone. Most businesses are arranged as teams. Within the teams, individual people are given specific assignments, and each team member contributes to the final product. For instance, the marketing department might have to prepare a sales forecast for the next six months. Each person could work on a specific sales region or product category. These individual pieces would then be merged into a single document. If the computers are networked, the manager's computer can pull the individual pieces from each of the individual computers. Also, each team member can be given access to the others' work to ensure that the reports use the same data and assumptions.

Groupware includes software that enables several people to work on the same document. Each individual computer has access to the master document. When one person makes a change to the document, the change is highlighted for everyone to read and approve. With existing international networks, each person might be located in a different country. E-mail systems can work as simple groupware

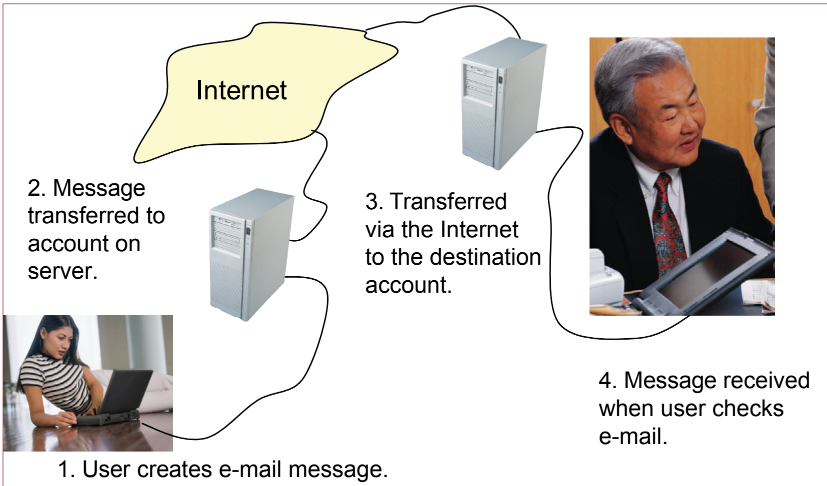


Figure 3.4

Networks for communication. With e-mail, a server holds the mail until the recipient logs on and can receive the message. Because several servers might be involved and each makes backup copies, e-mail messages are hard to delete.

tools by routing copies of files to everyone on the team. More sophisticated tools are included in Web sites built by systems like Microsoft's SharePoint. These tools are discussed in greater detail in Chapter 8.

Messages

Most people are familiar with electronic mail, or **e-mail**. With e-mail, you can send a message to any person with a mail account. Many people have come to prefer e-mail contacts to phone calls. As shown in Figure 3.4, e-mail messages are asynchronous since the sender and recipient do not have to participate at the same time. A mail server holds the message until the user logs in and retrieves the e-mail. Moreover, users can create mailing lists and send a message to many people at one time. Messages can be stored, retrieved, and searched for later usage. In most systems, the computer can automatically notify you when the recipient reads your message. You never have to worry about whether your message was received. Voice mail systems, which resemble answering machines, have some of these same advantages. However, e-mail takes less space to store. More important, e-mail can be scanned electronically to search for key topics.

E-mail has some drawbacks. For one, some people do not check the computer often enough to keep up with their mail. Another problem is that in 1991, the U.S. courts ruled that public transmission systems such as e-mail are not subject to the same legal protections for privacy as paper mail and phone calls. Unless the laws are rewritten, therefore, it is legal for employers (and almost anyone else) to read everyone's e-mail messages. Of course, the fact that it is legal does not make it ethical.

Examine the figure for a few seconds and another aspect of e-mail becomes fairly obvious. How can you delete e-mail (once it has been sent)? The answer is that it probably cannot be done. Even though some systems appear to give you

Reality Bytes: Worldwide Broadband Rankings

Akamai is an Internet company that provides services to many other companies. It specializes in distributing data around the world—putting it on servers closer to where it will be needed. This positioning gives the firm the ability to measure data flows and speeds around the world. An interesting statistic is the connection speeds of the people in each country. In 2010, the nations with the highest average connection speeds and their average speed in Mbps, were: 1. South Korea (17), 2. Hong Kong (8.6), 3. Japan (8.0), 4. Romania (6.8), 5. The Netherlands (6.5). Note that In South Korea, over 75 percent of the population connected to the Internet at speeds over 5 Mbps. The U.S. ranked 16 on the list of average speeds at 4.6 Mbps, and only 30 percent of the population had access to speeds over 5 Mbps. It is easier to build high-speed networks in nations with small physical space and large populations such as South Korea and Japan. Similarly, population areas in the U.S. such as the Northeast have more people with faster connections. But, ultimately, the speed available to the average person begins to matter—as companies rollout Web-based applications with sound and video.

Adapted from Karl Bode, Akamai: U.S. 33rd Fastest Broadband Country, www.dslreports.com, July 9, 2009. Updated data: http://www.akamai.com/stateoftheinternet

the option to delete or retract e-mail that has been sent, it generally will not work. Copies of the e-mail can exist in several locations—the original computer, the sender's e-mail server, the recipient's server, and the recipient's computer.

E-mail, and the fact that it is difficult to delete, has become an important aspect in legal cases—both private and those involving government officials. In court cases, many lawyers automatically ask for copies of all relevant e-mail in discovery motions. Consequently, many companies build **e-discovery** databases that contain copies of all e-mail messages sent through their servers. These systems have keyword search facilities so administrators can retrieve specific messages when required. The systems also have rules-based systems to handle retention policies. For example, company policies might specify that routine messages should be deleted after six months. The system can enforce retention and deletion policies automatically. Many of these systems also integrate voice mail messages with e-mail messages, so they are subject to the same retention, deletion, and discovery rules. The main point to remember is that any digital data might be stored for an unlimited time. So, although it is easy to think of electronic text and messages as ephemeral and fleeting comments, you should always remember that the potential exists for any message to be retrieved later.

You need to pay attention to two key aspects to any communication method: (1) Whether it is synchronous or asynchronous, and (2) The level of interruption it creates and the preferences of the people you work with. For example, a personal visit and phone call are synchronous, and the other person has to stop working on a task to talk with you. IM or texting is also synchronous, but users often feel more comfortable delaying these communications. E-mail is asynchronous, so each person works on his or her own schedule, and deals with mail during breaks. As the message sender, you have to choose the appropriate method of communication for each message and person. You also have to learn to allocate your own communication time, to leave sufficient time to finish your own work.

Web Site Basics

Web sites have evolved considerably, with several well-known sites providing services and applications to address many new tasks. However, many sites still exist in the early format—providing information and data. As a step up, some sites provide limited interaction, such as sales, feedback, discussion, and file sharing. At a higher level, a few sites provide greater interactivity—including games and online applications. The first decade of 2000 also saw the expansion of **social networking** sites—such as Facebook and Twitter. Social networking sites facilitate communications among groups of users. These types of sites and other capabilities are covered in more detail in Chapter 7 on e-business.

A key element of communication that is emphasized with the Internet and the Web is that communication only exists through the adoption of standards. **Standards** are simply agreements among the major users to handle tasks and data in a specific way. In terms of the Internet, standards exist for connecting networks and transmitting packets through routers. Common Web standards include **hypertext markup language (HTML)** which is the standard format for telling browsers how to display a page of text and images. These same standards can be used for other types of networks, including intranets and extranets. **Intranet** sites employ Internet technologies but use security methods to restrict access to internal users. For example, employees probably use an intranet to retrieve and update personal data in the human resources database. Similarly, **extranets** are sites specifically designed for companies that partner with your organization. For example, your suppliers can log into a special section to check on your production schedule, pick up technical specifications, or bid on jobs. Intranets and extranets use the same technologies as the common Internet, but are limited to special groups of users.

Several common Web tools can be used to support communication. Initial Web sites were designed primarily for one-way communication. They are still used for posting centralized data that is needed by many other people. However, interactive tools have also evolved to support feedback and communication within groups. Tools such as **instant messaging (IM)** can be used to send short messages to friends or coworkers. The messages are delivered instantly and can provide a way to ask questions or share ideas with team members who are online. Of course, cell phone texting services operate the same way, but the interaction requires a cell phone, or preferably a smart phone with a decent keyboard. The computerized IM tools can also be used to see when someone is online. If you are working late a night, you can quickly see which of the other team members are also online, so you know that you can ask a question without having to call everyone just to see if they are available.

A Web log or **blog** is an interesting variation of a Web site. The tools were created to make it easier to create and post content online and facilitate comments and feedback. Several sites provide public blogs enabling you to write comments on any topic. The software is also readily available for installation on internal company servers so managers can create blogs on topics that can be targeted to employees or to external partners. For instance, a blog could be used by managers to keep a log of the daily issues, problems, and solutions. Other managers in the company could skim the logs to see if problems arising in one area might cause problems in their own sections. Similarly, if a manager encounters a problem, he or she could search the blogs for similar problems, ideas on how to approach it, or even solutions that worked in the past. In essence, the blogs become a knowledge base that is accessible to other managers. Of course, the sites would be secured

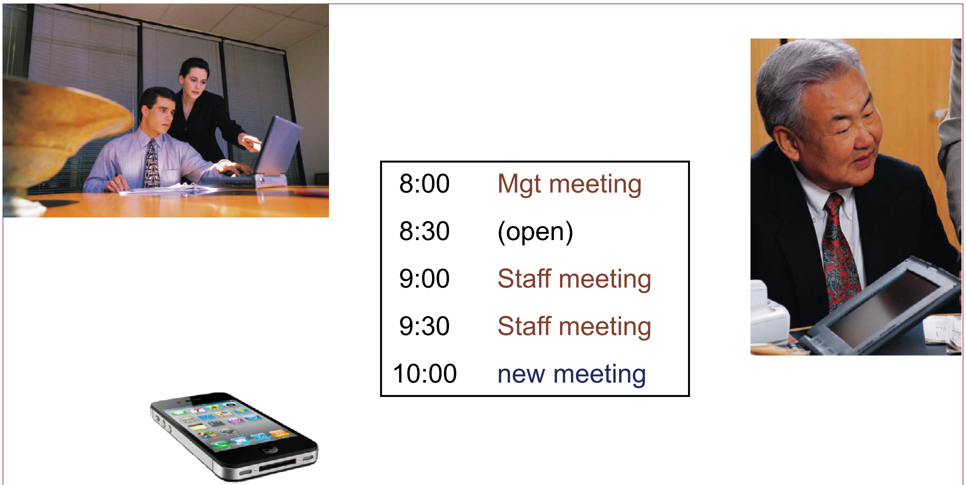


Figure 3.5

Sharing calendars. With the appropriate software, you can open your calendar to other members of your team. A team member can check the calendar and have the software find a common open time for a meeting.

so that only managers within the organization could read them. Some people are so dependent on blogs that they want to be notified whenever the information changes. **Really simple syndication (RSS)** feeds can be established so that your browser or reader automatically checks for new information and displays it automatically. It is even possible to connect your reader to your desktop so that any of your subscriptions are automatically displayed on the desktop when information changes. However, this approach is likely to be a major distraction to your work.

With the introduction of the Apple iPod, the concepts of blogs and RSS feeds was extended into audio notes that can be downloaded to the iPod and played later. These **podcasts** can be useful if you have time to listen to voice notes, but in business, it is faster to read and search written notes.

Wikipedia, the online user-supported encyclopedia has led to a new form of Web-based communication. You can use the same software to create in-house **wikis** where workers on a team can write their own descriptions, edit work by other people, and add comments. The entire system contains a search engine, so other employees can search the system for problem descriptions, work documents, and approaches or solutions used in prior cases. It is a powerful and inexpensive system when you want to record case-based data.

Calendars and Scheduling

Managers spend a great deal of time in meetings. Yet sometimes the greatest challenge with meetings is finding a time when everyone can get together. Several software packages use computer networks to solve this problem. As shown in Figure 3.5, managers enter planned meeting times and scheduled events into their personal electronic calendar file, where each event is assigned a priority number. For example, a time allotted for a haircut would be given a low priority; a meeting with a supervisor would receive a higher rating. If the CEO wants to set up a meeting, the CEO tells the computer which people are to be included, sets a pri-

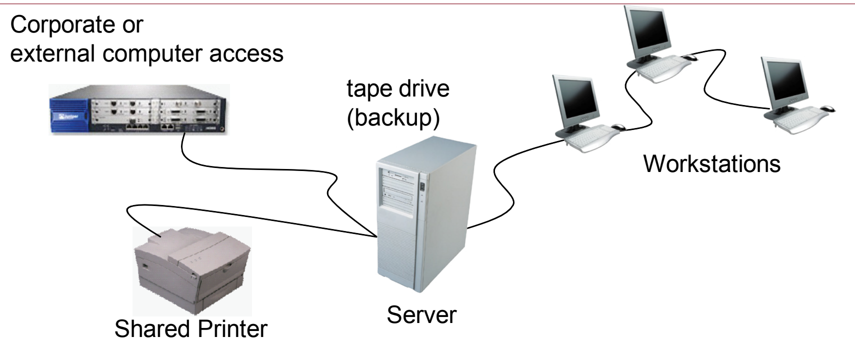


Figure 3.6

Networks for sharing hardware. The workstations use the server to perform backups. Files are picked up by the server and transferred to tape. The LAN administrator can reload a tape and restore files as needed. Networks are often used to share printers and storage devices. Networks can be used to share access to supercomputers—even if they are in a different city or different country.

ority level, and gives an approximate time. The computer then uses the network to check everyone else's schedule. When it finds an open time (overriding lower priority events if needed), it enters the meeting into each person's calendar. These systems can be useful when the calendar on your cell phone is connected to the shared calendar.

Sharing Hardware

Networks also enable workers to share expensive hardware. For example, networks are used to provide users access to special output devices, such as high-speed printers, plotters, or color printers. Networks can be used to give people access to special computers, such as when an engineer needs to use a high-speed supercomputer. Figure 3.6 shows some of the hardware devices commonly shared using a LAN: printers, tape drive backups, server processing, and external access to the Internet.

Printers

A common use of networks is to give users access to high-speed, high-quality printers. Even if each computer has a small personal printer attached, some jobs need to be handled by a high-speed laser printer. Many modern copiers now function as network printers and can collate and staple large quantities of documents. Similarly, even at $1,000 each it would be expensive to buy color laser printers for everyone who might need one, yet it might be reasonable to buy one for a department to share. With a network, users can choose from among two or three different printers by selecting them on the screen.

Another advantage is that if one printer breaks down, users can send their jobs to another printer on the network. Think about what happens if there is no network and your printer breaks down. You have to copy the file to a USB drive and interrupt someone else's work to borrow their computer to send the file to another printer. What happens if you are using a special software package that no one else has on his or her computer? You will probably have to physically move a printer from another computer desk to yours, connect the hardware, print your document,

Reality Bytes: Network Switches for Servers hit 10Gbps

As the amount of data on Internet and corporate servers continues to increase, network vendors are pushing new technologies to improve the transfer of vast amounts of data. In 2010, 10 Gigabit Ethernet is pushing into data center network design. Most data centers are built as vertical racks of servers, where each rack has a network switch at the top. In the past, these top-rack switches were connected to a middle-layer switch that then connected to the primary Internet backbones. But, hardware servers are increasingly used to host multiple virtual servers—and each virtual server pushes data across the network. Replacing the top-rack switches with 10 Gbps speeds and eliminating the middle layer speeds the data to the Internet connection. Robin Layland, an advisor to companies and vendors, notes that "Over the next few years, the old switching equipment needs to be replaced with faster and more flexible switches. This time, speed needs to be coupled with lower latency, abandoning spanning tree and support for the new storage protocols." IEEE standards are also being ratified for new switches to handle 40G and 100G Ethernet in the future. The speed increases are important in a cloud-based world where Layland notes that applications "require less than 10 microseconds of latency to function properly," compared to existing 50-100 microseconds. Jayshree Ullal, CEO of Arista Networks, a company that makes some of the new high-speed switches, notes that "most of the [existing] switches are 10:1, 50:1oversubscribed." Ultimately, companies save money by reducing the number of network switches—both in the cost of the equipment, maintenance, power, and air conditioning.

Adapted from Jim Duffy, "10G Ethernet Shakes Net Design to the Core," *Networkworld*, September 14, 2009.

and return the printer. When you are on a network, you simply select a different printer from a list displayed on your computer and go pick up the output.

Several e-commerce printing companies enable you to send your large print jobs over the Internet and have the boxes of papers shipped to you. All of the setup, pricing, and payment can be handled over the Internet.

Storage Devices

The arguments used for network printer sharing can be applied to sharing storage devices. If you have huge data files that you want to share across the organization, it is best to put them in a central location and provide network access to everyone who needs them. The central location makes it easy to upgrade the drives, provide sufficient capacity, and control the access rights and monitor security. A specialized **storage area network (SAN)** is often used to provide vast amounts of flexible storage. The disk drives are separated from the computers and connected by a high-speed network using fibre channel or high-speed LAN connections. Physically separating the secondary storage from the computer box makes it easy to expand the capacity, provide redundancy, and move the drives to safer locations. Because of the high transfer speeds across the SAN, the drives appear as simple local devices to the computer, so no software changes are needed.

Backup

Another important reason for sharing data over computer networks is that most people are not very good at maintaining backup copies of their work—especially on personal computers. If each computer is attached to a network, automatic back up can be configured two ways for individual personal computers. Individual workers can save their data files to a central file server. The network manager then makes daily (or hourly) backups of the data on the central server. A few companies even provide this service over the Internet. For a monthly fee, you can transfer your files to their server, giving you a backup copy—plus they keep backup tapes for the server. The second approach is to have backup software running on the server query each user's computer to obtain changed files and save them automatically. This approach requires that the client computers remain connected to the server and remain running, so it does not work well with laptops.

Special Processors and Grid Computing

Special computers that are relatively expensive can be attached to a network to save costs and make it easier for users to access these machines. Parallel-processing computers and other supercomputers can perform calculations thousands of times faster than ordinary computers, but they are expensive. Consider a small engineering company. For the most part, the engineers use their workstations to develop their designs. They occasionally need to run simulations or produce detailed graphics images. Both of these tasks could take many hours to perform on individual computers. With a network, each workstation can be connected to a supercomputer. When an engineer needs to perform high-speed calculations, the job is sent directly to the supercomputer. The results are returned via the network to the workstation so they can be added to the final report. More likely, a university could own the supercomputer, and the firm would lease time to run each job. If the network is designed properly, it makes no difference where the machine is located.

Grid computing extends the concept of parallel processing—instead of having multiple processors in one computer, you simply attach multiple computers together across a network. Remember that personal computers are relatively fast and inexpensive. When you can buy a new computer for $500, it becomes possible to build a huge amount of computing power by purchasing hundreds or thousands of computers and spreading the work across all of them. With special software, the job is split into multiple pieces and assigned to spare time on each computer. SETI @home is probably the best-known example of this type of computing. However, the same tools can be used within a single company—taking advantage of machines running overnight. Just keep in mind that running computers 24-hours a day substantially increases the power consumption.

Sharing Software

Networks have been used at different times to share software. When disk space was expensive, it was cheaper to put one copy of the software on a server and download it to each computer as it was needed. Today, it is possible to run software applications directly from a server, where client computers use Web browsers to connect to the server and run the software. This centralization of software and data leads to new ways to work and to manage companies. However, it raises issues of reliability and security. Some of these are covered in more detail at the end of this chapter. But the overall topics of management, centralization, and security arise in several other chapters.

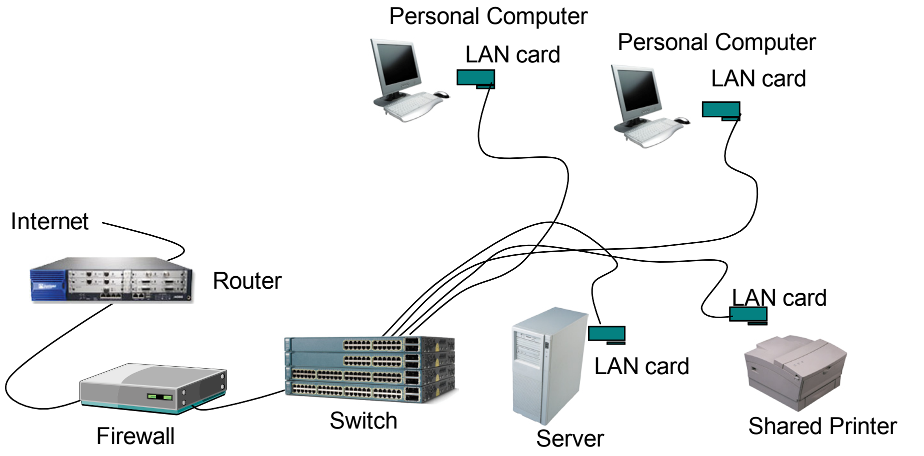


Figure 3.7

Network components. Networks require a transmission medium and each device connected must have a network card to make the connection. A switch connects the devices in the LAN, and a router connects the LAN to the Internet. A firewall is often used to filter out certain types of packets or messages so they do not transfer from the Internet to the LAN.

Components of a Network

What components do you need to install to create a network? As networks have become more important, the connection components are increasingly built into the computers. However, you still face many decisions about which technologies to use and how to solve problems, so all managers should understand the basic elements of a network shown in Figure 3.7. Each of these components (computers, transmission medium, and connection devices) is discussed in greater detail in this section.

Computers

Virtually any type of computer device can be connected to a network. The earliest computer networks consisted of one computer with several terminals and printers attached to it. These networks were fairly simple, because the one computer performed all of the work. Substantially more problems are involved in connecting several computers together. For starters, each computer needs to know that the others exist and that they have a specific location (address) on the network. The computers need to know how to send and receive information from each other. Just to connect to the network, they need LAN cards. Most desktop computers have built-in LAN cards and connectors for wired networks. Most laptops also have wireless network cards; some even have cards for cellular networks. For now, most companies run a combination of both wired and wireless networks. Most homes rely solely on wireless networks because no one wants to run cables through the house.

Computers attached to networks tend to perform one of two functions: servers or clients. Servers are computers that store data to be used by other computers attached to the network. Clients are computers used by individual people.

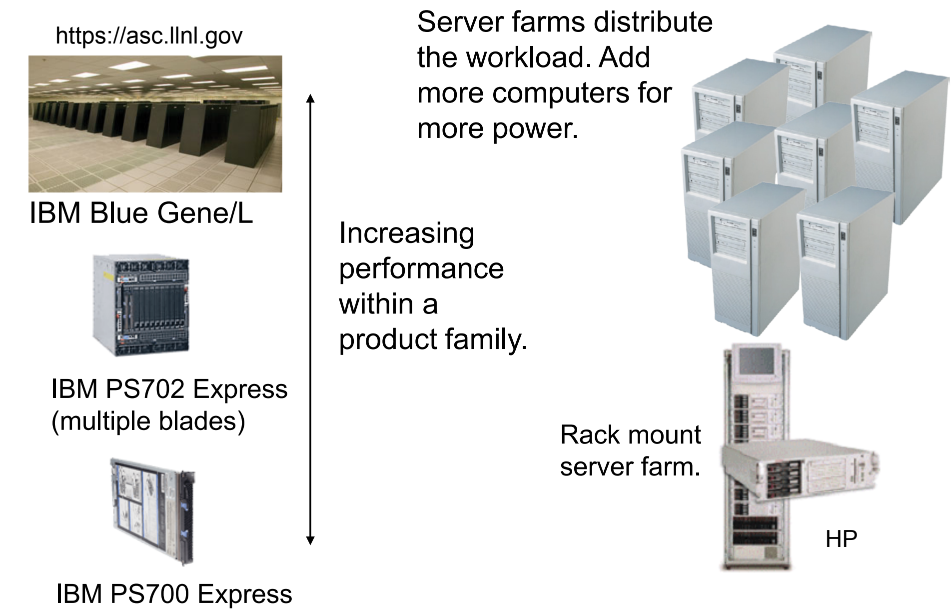


Figure 3.8

Server scalability. Two common methods of providing easy expansion of performance are (1) to purchase a faster performance server within the same product family, and (2) to build a server farm where the workload is automatically distributed across machines and new low-cost servers can be added at any time.

Sometimes a computer is used as both a client and a file server. Networks where many of the machines operate as both clients and servers are called **peer-to-peer networks.**

Servers

A wide range of servers exists today—from a simple PC to huge, expensive specialized computers. The main questions you face in choosing a server are the operating system and the issue of scalability, and the two questions are intertwined. **Scalability** is the ability to easily move up to greater performance—without having to rewrite all of your existing applications. Figure 3.8 shows two common methods used to provide scalability: (1) a vendor-provided range of servers from low-cost machines to handle small loads, to midrange, to high-capacity computers that can handle millions of users simultaneously; and (2) integration technology that enables the workload to be distributed across hundreds or thousands of small servers, known as a **server farm**.

Both approaches have their benefits. The single server is easier to configure and administer. The server farm can be expanded easily and cheaply without disrupting the existing applications. The operating system software is crucial to making a server farm work efficiently. Several vendors sell enterprise versions of software that assigns applications to the least-busy server and makes it easier to manage the server farm.

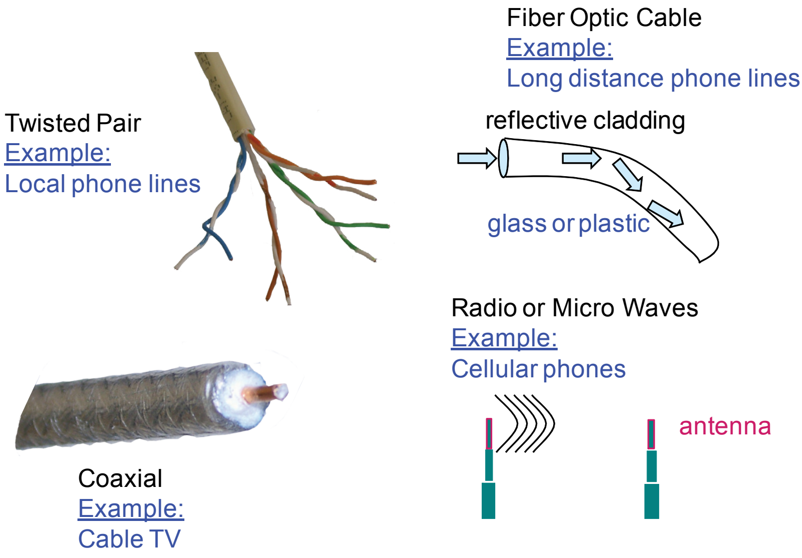


Figure 3.9

Signals can be sent via several types of media. They can be carried by electricity, light waves, or radio waves. All of these methods have advantages and disadvantages. Fiber optic cabling offers the fastest transmission rates with the least interference, but because it is relatively new, the initial cost tends to be higher.

Client Computers

The networked computers could be any type of machine. Because individual people at their own desks typically use these computers, they are often called client computers. These computers need to access the network and be able to send information to at least one other computer. A **network interface card (NIC)** (or LAN card) is installed in each computer. These cards are connected together by some transmission medium (e.g., cable). In addition, these computers might have to be configured to connect to the network and set security parameters. Client computers today include laptops and PDAs that can be connected with wireless networks to enable workers to maintain connections and share data while they move around the building.

Many of the mobile devices have limited capabilities and essentially run browsers, e-mail, and calendars. Hence, more of the processing is done on the server, and the mobile device is only responsible for displaying data and basic user interface tasks. This type of environment is considerably different from the situation where all workers have desktop machines capable of handling large amounts of the processing. The thin-client cell-phone applications rely on the server, while the desktop applications simply use the server for basic data sharing. Developing applications for this new environment requires some major changes in design, programming, and security—issues that will be explained in detail in other chapters.

Transmission Media

All communication requires a **transmission medium**. As illustrated in Figure 3.9, common methods include electric wires, light waves, and radio waves. Each

Reality Bytes: Excess Capacity

Partly because of crazy predictions of Internet growth, partly because of economies of scale, and partly because of improved technologies, several long-haul data-transmission companies overbuilt when installing fiber-optic cables. In late 2002, only 2.7 percent of the fiber was being used—a whopping 97.3 percent was dark. Over time, economics prevailed and bandwidth prices dropped—at a rate of 65 percent per year. Many of the large telecommunications firms filed for bankruptcy. The bankruptcy filings generally erased the debts of the companies—enabling them to charge even lower prices when returning. Prior to 1995, telecommunications companies could send the equivalent of 25,000 one-page e-mails per second over one fiber-optic line. By 2002, advances in technology enabled them to send 25 million messages over the same line—an increase of one thousand times. The new technology called dense-wave division multiplexing (DWDM), effectively splits light into multiple colors—enabling the companies to send different messages on each color frequency. By 2011, demand had started to cut into some of the excess capacity, but not enough to begin installing significant new cables.

Adapted from Dreazen, Yochi, J., "Wildly Optimistic Data Drove Telecoms to Build Fiber Glut," *The Wall Street Journal*, September 26, 2002; and Berman, Dennis K., "Technology Races Far Ahead Of Demand and the Workplace," *The Wall Street Journal*, September 26, 2002.

method offers certain advantages and disadvantages, so they are designed for specific applications. Installation costs for all types of cables are high, and most organizations keep cabling in place at least 10 years. Consequently, you have to be careful to research the technologies when installing new cables to ensure you will be able to support future needs.

Electric Cables

The two basic types of electric cables are twisted pair and coaxial. Twisted pair is the oldest form of electrical wiring. Since electricity must travel in a closed loop, electrical connections require at least two wires. **Twisted-pair** wires are simply pairs of plain copper wires. Telephone cables are the most common example of twisted-pair wires in households. Because of the cost, most businesses have already installed twisted-pair wires—typically a specific version known as Cat 5 or Cat 6. These standards define four pairs of wires. Older, slower networks (100Base-T Ethernet) uses only two of the pairs (4 wires), but higher-speed networks (gigabit Ethernet) require all eight wires. Because of the extensive use of Cat 5 cables, the network industry has invested considerable research into maximizing the data that can be carried over that type of cable. However, newer high-speed transmissions systems might require better cables. The Cat 5e (enhanced) standard would be the minimum for installing new cables, and depending on price and location, you might consider Cat 6 or Cat 7, which is heavily shielded. But check the prices. Cat 7 cable can be five times more expensive than Cat 6

The biggest drawback to twisted-pair wires is that they are not usually shielded. Consequently, the data signal is subject to interference from other electrical appliances or cables. In particular, never run data cables next to power lines or electrical motors. Additionally, the data cable length for most LANs must stay under 90

Reality Bytes: LightSquared v. GPS

LightSquared is a startup company with a new technology to create a national wireless broadband system. The plan would entail installing 40,000 antennas around the country. In early 2011, the company signed agreements with Best Buy and Leap Wireless to enable them to sell wireless Internet access. Adding a new provider like LightSquared would ultimately provide more options for consumers and provide competition to ISPs such as the cable and phone companies. It would also provide competition to mobile phone carriers. However, the frequencies LightSquared wants to use are near the frequencies used for satellite signals—particularly low-powered GPS signals. In testing, the LightSquared devices were found to interfere with high-end GPS devices, particularly those used by aviation, police, and agricultural applications. For instance, John Deere, the tractor company, said the devices created severe interference as much as 20 miles away and "complete loss of service" between four and 22 miles. LightSquared's executive vice president for regulatory affairs and public policy, Jeff Carlisle, noted that "LightSquared and BPS can and will be able to coexist peacefully. We're committed to identify and resolving the issues through this process." Ultimately, the FCC will decide whether to move forward and what changes might have to be made. LightSquared later announced that it was moving to a different frequency farther away from the GPS signals.

Adapted from Amy Schatz, "LightSquared's Wireless Network Interferes With GPS," *The Wall Street Journal*, June 2, 2011.

meters (about 300 feet). You can extend the length by adding switches, but you will be amazed at how quickly you can run into the limit when a cable needs to turn corners and travel multiple floors. Despite these drawbacks, twisted-pair wiring is the most common LAN cabling method in use today. Largely because of the cost and the research that has led to huge performance capacities. Standard Cat-5e wiring is capable of carrying data at 1,000 megabits per second (gigabit).

Coaxial cables were designed to carry more information than twisted pairs, with lower chances of interference. **Coaxial cable** (often shortened to coax) consists of a central wire surrounded by a nonconductive plastic, which is surrounded by a second wire. The second wire is actually a metallic foil or mesh that is wrapped around the entire cable. This shielding minimizes interference from outside sources. Cable television signals are transmitted on coaxial cables. Coax is capable of carrying more information for longer distances than twisted pair. But, it is more expensive and is rarely used outside the television industry.

Fiber Optics

A relatively recent invention (early 1970s) in communication uses light instead of electricity. Because light generally travels in a straight line, it could be difficult to use for communication. Fiber-optic cable allows light to travel in straight lines but still be bent around corners. A fiber-optic cable consists of a glass or plastic core that is surrounded by a reflective material. A laser light is sent down the cable. When the cable bends, the light is reflected around the corner and continues down the cable. Fiber-optic cable provides the advantages of high capacity with almost no interference. The limitation in using fiber is the higher cost of the cable and the cost of the connectors and interface cards that convert computer electrical signals into light. For example, NICs for coaxial or twisted-pair cables can be purchased for around $10, whereas NICs for fiber-optic lines that run directly to personal computers range from $50 to $400 (in 2011). The cards are harder to find and more expensive, because it is rare to use fiber lines to the desktop. A study by Partha Mitra and Jason Stark showed that even fiber-optic cables have limits. The theoretical capacity of a single fiber-optic cable is at least 100 terabits per second (*The Economist* June 28, 2001 or *Nature* June 28, 2001). In 2011, two researchers achieved this speed in demonstrations reported by *New Scientist*. Although it is possible to run fiber optics directly to your desktop, it is rarely worth the expense. Fiber-optic connections are used for long distances, in areas with electrical interference, or when connecting buildings. In the mid-2000s, Verizon, the local telephone company (not the cellular phone company) began installing thousands of miles of fiber cables directly to customer homes. The FiOS service is designed to provide high-speed Internet connections (20 mbps or more), and ultimately video on demand and other data-intensive services. Installing the fiber into homes is challenging because although fiber cable does not have to be perfectly straight, if it is bent too sharply or too many times, the light will bleed out at the corners and the signal will disappear. Corning has an answer with a new fiber that contains nano-particles to allow fiber cables to be wrapped around objects as small as a pencil and still carry the light signal. However, it might take a couple of years to create a factory that can produce the cable in large quantities (Mehta 2007).

Radio, Micro, and Infrared Waves

Radio, microwave, and infrared transmissions do not require cables. These communication methods are called **broadcasts**. Any receiver or antenna that lies in its path can pick up the signal. However, infrared transmissions and some microwaves require clear line-of-sight transmission. The major advantage of broadcast methods is portability. For example, computers can be installed in delivery vehicles to receive information from corporate headquarters. Or individuals can carry around laptops and cell phones and remain connected to the network. These computers can communicate with each other and with a central database via a broadcast network. For example, physicians in hospitals can carry small computers that automatically receive information for each patient when the physician enters the room. Any instructions can be sent directly from the physician's computer to the nursing station. In the business world, you can carry a cell phone or tablet that maintains contact on the Internet to retrieve e-mail or scan Web sites while you are in meetings, other offices, or a client's office.

Broadcast media have two primary drawbacks. First, it is more important to provide security for the transmissions. Second, broadcast transmissions are limited to a defined frequency range, which might be subject to weather, echoes, or other interference and distance problems. Consequently, because the frequency space is shared, it can become overloaded when too many people attempt to transfer large amounts of data at the same time in the same location.

The problem of limited capacity arises because only a small number of radio frequencies can be used to carry data. Most of the radio and television frequencies are already being used for other purposes. Figure 3.10 shows some of the major frequency allocations in the United States. The Federal Communications Commission (FCC) allocated the personal communication service (PCS) bands in late 1993 for use by personal communication devices such as laptop computers and personal digital assistants (PDAs). To provide these frequencies, the FCC had to

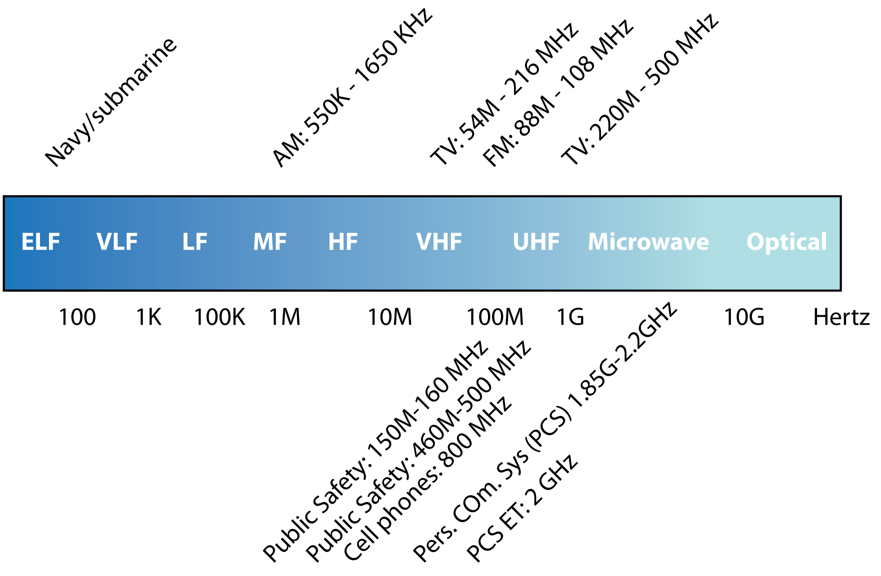


Figure 3.10

Electromagnetic frequency spectrum. Communication techniques are essentially the same for all media, because all waves physically have similar properties. However, the different frequencies affect the communication performance. Shorter wave lengths (higher frequencies) can carry more data. Some waves can travel longer distances. Others are more susceptible to interference. In any case, there are a finite number of frequencies available for communication. Hence, the frequency spectrum is allocated by governmental agencies. For complete details, see http://www.ntia.doc.gov/osmhome/allochrt.pdf.

take them away from existing users. Imagine what would happen if computers suddenly started sending information over the same radio frequency as that used by your favorite radio station. You would not be able to hear the voices on the radio, and the computers would miss most of their data because of the interference.

All governments allocate the frequency spectrum for various uses, such as radio, television, cellular phones, and garage door openers. The PCS frequencies were auctioned off to the highest bidders in 1994, raising more than $65 billion. The frequency problem is even more complicated when the signals might cross political boundaries. As a result, most broadcast telecommunications issues are established with international cooperation. Some of the overcrowding problems are being mitigated through the use of digital transmissions that cram more calls and more data into the same amount of frequency space.

Despite these problems, an increasing amount of business communication is being carried over radio networks. The International Telecommunication Union reports that in 2002, both Taiwan and Luxembourg averaged about 105 cell phone users per 100 people! In comparison with broadband Internet connections, in 2010, The Netherlands led the way where 37.8 percent of the population had broadband Internet access. The United States was ranked 14 at 27.1 percent; below Belgium, Canada, the United Kingdom, several European nations, and Korea. (source: http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.

Reality Bytes: Please Stop Watching Video So I Can Send e-Mail

From late 2010 to 2011, cell phone companies began rolling out fourth-generation (4G) services. Or they called them 4G service. Some, such as Verizon's LTE, have substantially faster data transmission rates. Early reports showed download speeds of 12 Mbps or more on Verizon's LTE network—although minimal competition existed so speeds might drop. Through more efficient use of the available bandwidth, LTE can provide as much as 20-times the capacity of older 3G networks. The only problem is that mobile data traffic is growing even faster. Cisco expects traffic to increase by an average of 92 percent every year from 2011 through 2015. Most of that growth will be due to video. Cisco's estimate might actually be low. Over the first four years that AT&T sold the iPhone, data traffic on its networks increased 8000 percent. Patrick Lopez, chief marketing officer for Vantrix, noted that "By the time 4G-LTE is mass market, all it will have done is allow wireless companies to keep up with the problem." The FCC notes that the wireless spectrum surplus of 255 MHz in 2011 will become a deficit of 275 MHz by 2014. The government is committed to freeing up an additional 500 MHz of spectrum for wireless communication. Wireless spectrum and efficiency is a critical issue to handle traffic between towers and users' cell phones. Backhaul, or the connections from the towers to the main Internet connections, is another problem. The big problem is that all of these changes take years to implement. In the short run, wireless providers are likely to advertise high-end video capabilities, and then charge a fortune to download the amount of data needed for high-quality video.

Adapted from David Goldman, "4G Won't Solve 3G's Problems," *CNN Online*, March 29, 2011.

html). On the other hand, advertised broadband download speeds in Japan and Portugal greatly exceed those in the other nations; running at slightly over 100 megabits per second, versus about 14 megabits in the United States (OECD data). The OECD data show monthly prices in Japan are about equal to U.S. prices. In US dollars, from $20 – 55 per month.

Although wireless Internet connections are not yet as fast as broadband connections, it is substantially less expensive to reach people with wireless connections. Already, in many nations, the number of cell phone subscribers exceeds the number of fixed telephone subscribers. According to the OECD, Korea tops the national list in terms of percentage of the population that has wireless broadband access (95 percent). In the U.S. 44 percent of the population had broadband wireless data plans.

Wireless is an increasingly important method for connecting computers and equipment. Historically, cables were the most common method of connecting machines, but people keep acquiring more devices and the tangle of cables is getting out of control. In addition, people are placing more value on portability and the need to access networks and data constantly. As a result, Figure 3.11 shows that multiple levels of wireless connections are being developed. In terms of wider network connections, you can use the cell phone system or WiMax which give you a range of 2-10 miles from an antenna. These frequencies are shared and usually regulated, so you have to purchase access through a commercial carrier (phone company). Availability is generally limited to major cities or highways, but are

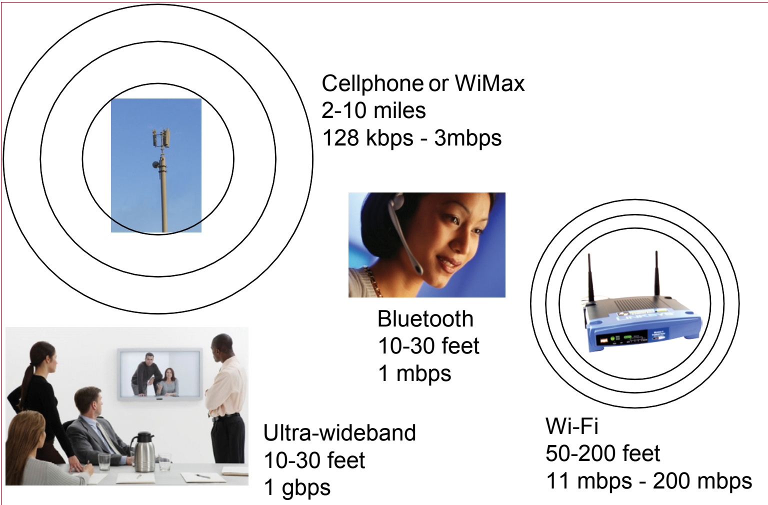


Figure 3.11

Wireless technologies. Competition for bandwidth causes tradeoffs. Wide-area technologies like cell phones and WiMax have limited bandwidth to reduce interference. Wi-Fi is a medium-range local area network technology. Bluetooth and Ultra-wideband are personal area technologies used for replacing cables for short-range connections.

acceptable for most business uses. **WiMax** is a relatively new technology that is designed to transfer wireless data over relatively long distances. Two primary frequency ranges are used—the most common one requires a license in the U.S. but not in Europe, so it is best used by commercial providers.

Most people are familiar with **WiFi** technologies because access points are relatively inexpensive and commonly installed in homes. WiFi enables multiple computers to connect to an Internet connection and is particularly useful for enabling laptop users to wander around a house or small office and remain connected to the network. Early versions were relatively slow and could support only a few users. The newest version (802.11n) can have data rates of 100-200 mbps or perhaps higher. The key defining feature of WiFi is that it has a maximum range of about 300 feet (outdoors). This range reduces interference from other devices, but means businesses have to install multiple access points to cover large buildings.

After several years of marketing by IBM, the **Bluetooth** wireless standard is becoming more popular. It has a range of 10-30 feet and version 2 has a maximum speed of about 2 mbps. The proposed version 3 increases the speed to 24 mbps. Today, Bluetooth is commonly used for connecting wireless headsets to cell phones. It could also be used to connect cell phones to each other or to other devices, but there are almost no other applications that use this technology at this time. The distance limitation and the built-in security provisions make it useful for short-distance, temporary connections.

From a technology perspective, **ultra-wideband (UWB)** is a more interesting short-range wireless technology. Unlike traditional wireless systems, UWB signals use a huge amount of frequency bandwidth (more than 500 MHz). Normally, this approach would interfere with other devices allocated to those frequencies,

LAN Name	Format	Speed (mbps)
10Base-T	Twisted pair	10
100Base-T	Twisted pair	100
Gigabit Ethernet	Twisted pair	1,000
Wireless LAN 11b, a,g	Wireless	11-54
Wireless LAN 11n	Wireless	250
fiber FDDI	Fiber optic	100
fiber ATM	Fiber optic	155
fiber high-end	Fiber optic	100,000,000 (100 terabits)

Internet Connection	Format	Speed (mbps)	Estimated Cost
Dial-up	Twisted pair	0.05	$20/month
DSL	Twisted pair	1.5+ down/0.5 up	$50/month
Cable modem	Coaxial	6+ down/1 up	$50/month
Satellite	Microwave	1.5 down/0.25 up	$50/month
Wireless/WiMax	Microwave	1.5-6 down/0.25+	$40/month
T1-lease	Twisted pair	1.544	$400-$700/month
T3-lease	Fiber optic	45	$2,500-$10,000/mo
ATM	Fiber optic	155	$15,000-$30,000/mo
OC-3	Fiber optic	155	$16,000-$20,000/mo
OC-12	Fiber optic	622	$20,000-$70,000/mo
OC-48	Fiber optic	2,488	$50,000-?/mo
OC-192	Fiber optic	9,953	
OC-768/future	Fiber optic	39,813	

Figure 3.12

Transmission capacity. Fiber-optic cables have the greatest capacity and they are immune to most traditional interference. However, they are expensive to install and repair. Most firms use twisted-pair or wireless connections within buildings and fiber-optic cables to connect buildings. You can purchase almost any Internet connection speed that you are willing to pay for. Leased line rates are negotiable and depend on distance and degree of local competition.

but UWB devices use low power levels—so that they appear as minor noise to any other device and are ignored. With the low power levels, they have a range limited to a few feet. On the other hand, UWB signals can carry huge amounts of data, in the range of 500 mbps to 1 gbps. This speed provides the ability to eliminate short cables for many devices—including video. For example, your digital camera or game machine could use UWB to connect to a television set without using cables, or your laptop could connect to the conference room projector without wires. At the moment, UWB is most commonly used for its side application—as short-range radar that can see through walls. Police and military organizations use this technology to locate people in crisis situations.

Transmission speed	Text	Image	Video (10 sec.)
Bytes	10,000	500,000	15,000,000
Bits (Bytes * 8)	80,000	4,000,000	120,000,000
	Seconds		
Dial-up 50 kbps	1.6	80	2400
DSL 1.5 mpbs	0.05	2.67	80
LAN 10 mbps	0.008	0.4	12
LAN 100 mpbs	0.0008	0.04	1.2
Gigabit 1 gbps	0.00008	0.004	0.12

Figure 3.13

Importance of transmission capacity. Text is not a problem even for slow dial-up lines, but images and video can be slow even over relatively high-speed Internet connections.

Transmission Capacity

As shown in Figure 3.12, transmission capacity is often measured in millions of bits per second. Each transmission medium has a different maximum capacity. Twisted pair can be relatively fast for short distances, but fiber optic is substantially better for longer distances. Getting a faster Internet connection is primarily an issue of cost. Fiber-optic cable might also carry a high installation cost if there are no fiber-optic connection points near your office. Today, twisted pair lines are commonly used for local area networks, but each connection run must be less than 95 meters (about 300 feet). Fiber optic lines are used between buildings and for long-distance connections.

The effect of the transmission capacity is shown in Figure 3.13. For small text and data files, the speed is not critical. Even slow dial-up lines can transfer a full page of text in a short time. The problem arises when you want to transfer more complex data like photos or even video. This figure shows why designing Web pages carefully is still so important. When over 75 percent of your clients are using dial-up lines, you need to limit pages to around 50,000 bytes, which takes at least 8 seconds to download. Most people will not wait more than 15 seconds for a page to load. Now you can see why Internet video is so difficult even with marginal quality. Even with video at broadband speeds of 1.5 mbps, site designers have to restrict the video to small sizes (one-fourth of a TV screen or smaller), use slower frame rates (as low as 15 frames per second), and employ lossy compression. These actions cut the video size by at least 1/8 (1/4 size * 1/2 frames). At that size, the 10 seconds of video could be sent in 10 seconds (80/8). Compression lets the developer specify a bit rate, and sites like YouTube tend to stay under 256 kbps, which reduces the quality.

Transmission delays are another important issue for some types of network uses. **Latency** is the time it takes for your signal to reach its destination. It is affected most by the speed at which the signal can travel across your connection medium. Fiber optic signals are fastest because they travel at the speed of light

Technology Toolbox: Creating Web Pages

Problem: You need to share information with others on the Internet.

Tools: Several tools exist to create Web pages, but at heart, Web pages are simply text files. The pages are written in the hypertext markup language (HTML). HTML consists of a few dozen tags that tell the browser how to display a page. A simple page can be written as:

```
<HTML>
  <HEAD><TITLE>Sample HTML Page</TITLE>
  <BODY>
    <H1>Section One</H1>
    <P>This is a sample paragraph on a sample page.</P>
  </BODY>
</HTML>
```

You can memorize the various tags, or you can use an editor to simply type the text and let it generate the tags. However, if you are creating pages for the Internet, avoid using document editors like Microsoft Word because the additional material it inserts makes the pages considerably larger than necessary.

Web pages display images using the <IMG SRC='myfile.jpg'> tag. You must be careful when creating image files to store them in a standard format: (1) graphics interchange format (GIF), (2) joint photographic exports group (JPEG), or (3) portable network graphics (PNG). You must be even more careful to watch the size of the file. A modern digital camera can create photographs that are 15 megabytes! Think about how long it would take a browser to download a file that large. In general, you must keep the total size of a page below 100 kilobytes.

Links are created with the anchor tag: Annual Results. The text or image between the starting and ending tags will be displayed to the user. Clicking on the link opens the file shown in quotes.

When you are creating an entire Web site, you need to use a style sheet. A style sheet contains a list of styles (fonts, sizes, colors, margins, and so on) that will be applied to the various elements on a page. For instance, you could specify that the main heading style (H1) would use an Arial typeface at 14 points in blue. The power of the style sheet is that all styles are defined in one place. By changing the style only once, every page on your site that is linked to that style sheet will automatically be displayed with the new style.

HTML is easy to use, but if you need more precise control over the page layout, you should use Adobe's portable document format (pdf). You can buy software that saves documents in this format. Browsers can download the Acrobat reader free from Adobe's Web site. This method is commonly used to distribute detailed documents such as t ax forms and posters.

Quick Quiz: Search the Web, or create a document and View the source to do the following:

1. Display a word or phrase in boldface.
2. Link a style sheet to an HTML page.
3. Display a table with three rows and four columns.
4. Display a numbered list of five items.
5. Display an icon in GIF format with a transparent background.

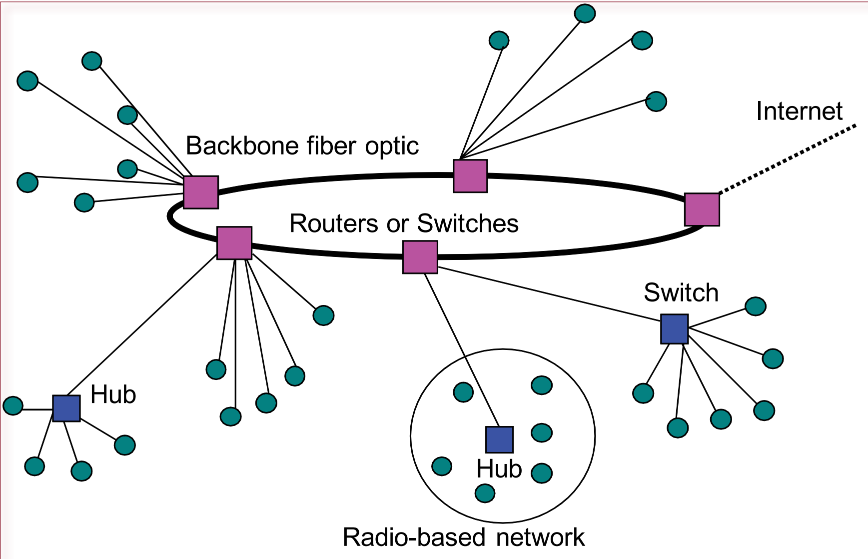


Figure 3.14

Connecting networks. Several challenges arise if you build an enterprise network. An enterprise network often connects many smaller networks established in different departments, buildings, or even nations. The hardware and software components must follow standards so they can communicate. An MIS team has to manage the overall structure to maximize efficiency, avoid duplication, and solve problems.

and require fewer repeaters. Electrical signals are also relatively fast, but the overall latency can be higher if the signal needs to travel through multiple repeaters or switches. Microwave signals tend to be the slowest and subject to interference from the weather. Satellite connections tend to have the most latency because the signal has to travel from the ground, across 23,000 miles of space to a satellite and another 23,000 miles back down to the base station. This delay can easily reach a half-second or more and makes it difficult to use satellite connections for some purposes—such as multiplayer games. Note that latency is independent from the bandwidth—so an ISP can advertise that it provides a 1 mbps satellite connection, but the delay due to latency might cause problems with how you want to use the network.

Connection Devices

To reduce overall traffic, larger organizations often find it beneficial to build the corporate network from a set of smaller networks. Both large and small companies use similar techniques to connect their networks to the Internet. Figure 3.14 shows a common configuration. Computers within a building or smaller area are linked into a hub, switch, or router. This interconnection device is then linked to the backbone, which is typically a fiber-optic line. A specially-configured router then connects to the Internet.

If you look at the physical box, it can be difficult to tell the difference between a hub, router, and switch. However, internally, they function quite differently, and you need to understand those differences to decide how a network should be configured. Hubs are the simplest connection devices. They essentially act like a gi-

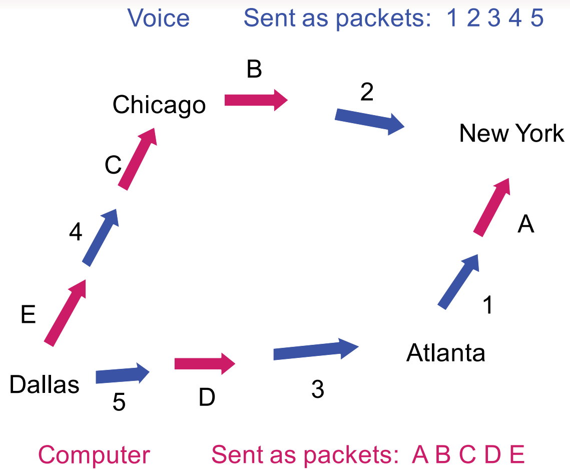


Figure 3.15

Network packets. All data is converted to digital form and broken into small packets. Each packet contains a destination and source address, along with sequencing instructions. The packets can be sent over different routes or mixed with other packets. At their destination, the original message is restored by the network.

ant junction box. Any device connected to a hub shares all of the lines with the other devices. It is just a mechanism to plug several computers together. Switches and routers actually examine every packet that passes through them and decide where to send each packet. They are actually specialized computers that can be programmed to identify network problems and intelligently route traffic to the fastest route.

Routers and switches are crucial to improving efficiency in large networks. In many respects, a router works like a post office. It examines the destination address of each packet of information and selects the best way to send that packet. Routers and switches improve performance by choosing the path of the message and segmenting large networks into smaller pieces. For example, router segments might be assigned to each department of a large company, where each department has its own server. Most of the messages stay within the specific department, so they do not take up bandwidth across the entire company. Only messages that truly need to be sent to other areas will be transmitted outside the departmental segment.

The main differences between switches and routers consist of how each one identifies other objects on the network. Switches use physical addresses that are assigned to each network interface card. Routers use a logical address that is easier to change. Routers also contain more intelligent routing algorithms. They can analyze traffic patterns and communicate more data with other routers to find the best transmission path. Switches are commonly used to isolate traffic within a local area network, and routers transfer data across longer distances and more complex networks such as the Internet. It is possible to build a network entirely based on routers, but it is usually cheaper to use switches where possible. Just keep in mind that most switches cannot transfer data beyond seven hops, so if you need lots of connections, you will have to add routers.

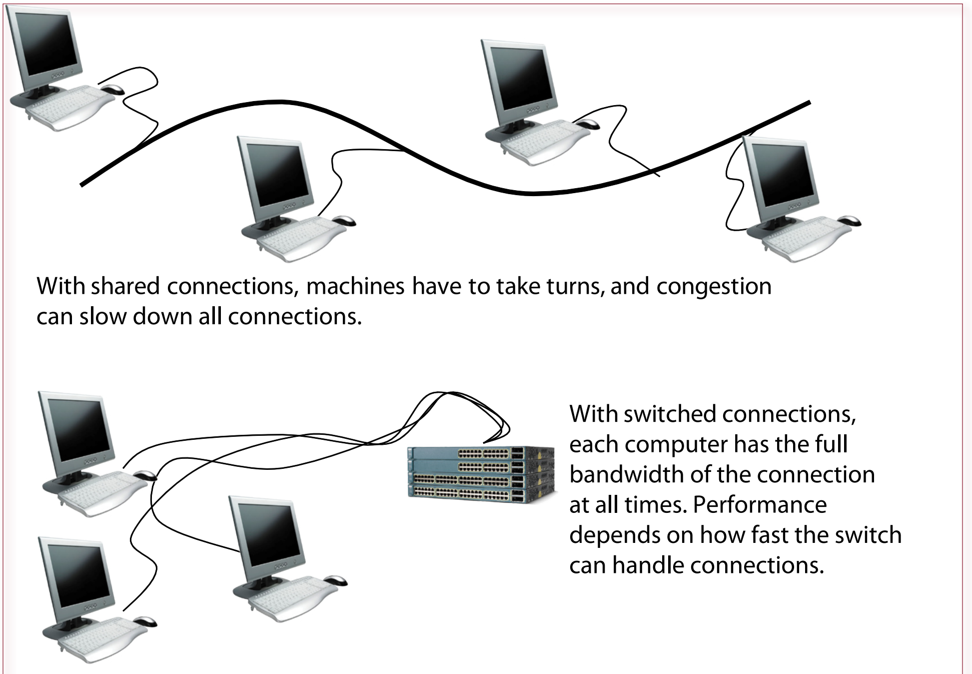


Figure 3.16

Shared connections. Some networks rely on sharing the transmission medium with many users. Sharing means computers must take turns using the network. Sometimes one or two highly active users can slow down the network for everyone, so you will not really get the listed transmission capacity.

Network Structure

How can multiple users share a single network? Transferring data between two devices is relatively easy—you just find a way to physically connect the two computers and install some software to handle the communication. You might be able to build a network that works the same way—by connecting each computer to every other computer. But eventually the cabling costs would be huge. Instead, at some point communications travel over a shared link. Think about a network between two cities (say Los Angeles and Boston). Computers within each city might be connected to each other, but they all share one long-distance line to transfer data between the two cities. Almost all networks are built using shared communication links. Several methods exist to share data connections, and the method can affect the overall performance of the network. But, it is also important to remember that the number of people and their usage of the network will affect your performance. Shared networks require careful management—particularly when a few "bandwidth hogs" exist.

Network Packets

A key feature in sharing networks is that data is transmitted in small batches. All data, including voice and video, is converted to digital form. The data is split into smaller **packets** that contain a source address, destination address, and a sequencing method. The packets tend to be a uniform size (a couple thousand bytes) and

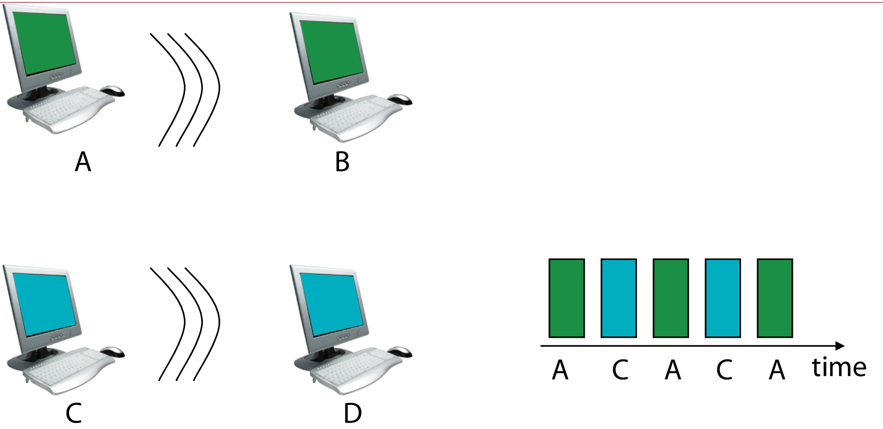


Figure 3.17

Time division. Only one machine or person can send data at a time. Data is limited to short packets to prevent one communicator from monopolizing the time.

prevent one user from monopolizing the connection. They also make it easy for a single network to handle data, voice, images, and video. The network simply focuses on routing the packets to the appropriate destination. Figure 3.15 shows an example of voice and computer data being sent over the same network. The switches and routers choose the best path to send the data when each packet arrives. The network delivers the packets to the appropriate receivers in the proper sequence.

Today, most networks use the protocols defined in the Internet standards. The Internet is capable of carrying any type of data packet; however, one catch with the standard Internet is that there is no service guarantee. Your packets could be delayed or lost along the way. Most applications have a method for recognizing lost packets but it takes time to retransmit the packet. This issue is minor for Web sites and e-mail, but can become annoying if you want to use the connection for phone calls. Newer versions of the Internet protocols provide support for guaranteed levels of service. But, so far network companies have not devised methods to implement and charge for **quality of service (QOS)**. Part of the problem lies with the need to communicate across networks owned by multiple companies. There is also a question of whether people are willing to pay extra for a defined level of quality. However, it is possible that someday you will be able to conduct video meetings by reserving a certain level of speed at a set time.

Shared Connections

Figure 3.16 shows that individual machines can be connected to a shared medium or they can be connected individually to a switch. However, the switch uses a shared medium to connect to other switches and routers; so ultimately, connections are shared at some point on almost any network. Wired local area networks commonly use switches to separate traffic within departments or physical areas. Wireless (and cell phone) networks require all computers to share the same radio frequencies. Some of the most advanced sharing technologies have been created to handle the huge increases in traffic experienced with cell phone networks.

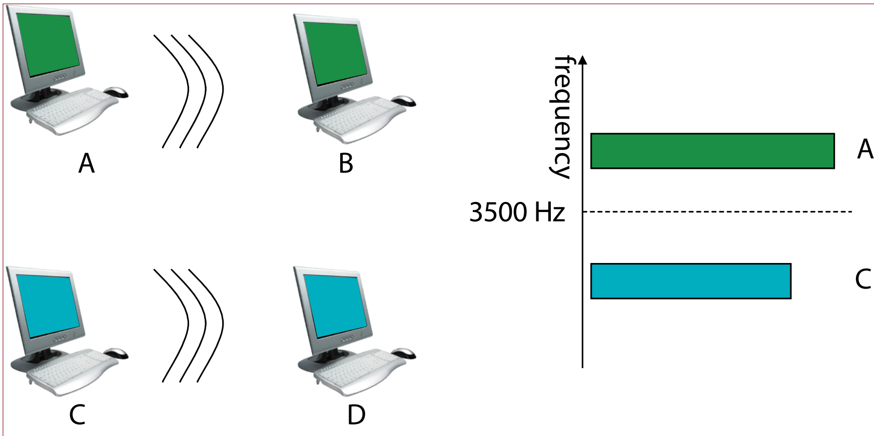


Figure 3.18

Frequency division. Each pair communicates at a different frequency (pitch). Radio and television stations work this way by using assigned frequency ranges (channels).

In theory, all communication systems that share a communication medium share the same problems. The solutions to the problems are similar regardless of the communication technology. In practice, engineers point out that the techniques require considerable modification depending on the physical connection method, but you will have to study the engineering books to understand those details. For now, think about the protocols that people have created to handle a common shared-communication environment: the classroom.

What happens if everyone tries to talk at the same time in a classroom? Is it possible for more than one person to talk at one time? The common answer is that only one person is allowed to talk at a time. A signaling mechanism (raising your hand or being recognized by the leader or instructor) is used to identify which person gets to speak. Typically, the leader also limits the time any person is allowed to speak. Figure 3.17 illustrates the basic process of **time division multiplexing (TDM)**. Only one machine or person can communicate at a given time. Rules or protocols determine who gets to send a packet, what to do if two machines try to communicate at the same time, how to address the packets, and the length of the packets.

If you think about the problem for a while—and engineers have been thinking about the problems for many years—you might find a second solution. If everyone's hearing is good enough, it would be possible for two people to carry on a conversation at the same time in the same room. Simply ask one pair to communicate at one frequency (sing soprano), and the other pair to communicate at a different frequency (sing bass). In electronics terms, it is relatively easy to share a communication line by using this **frequency division multiplexing (FDM)**. Figure 3.18 shows the basic process—it has been in common use for decades. Radio and television stations are assigned separate channels (frequency ranges) so they can broadcast at the same time without interfering with each other. The telephone network was an early adopter of this approach—limiting the frequency range of conversations to about 3000 Hertz and shifting connections to different frequen-

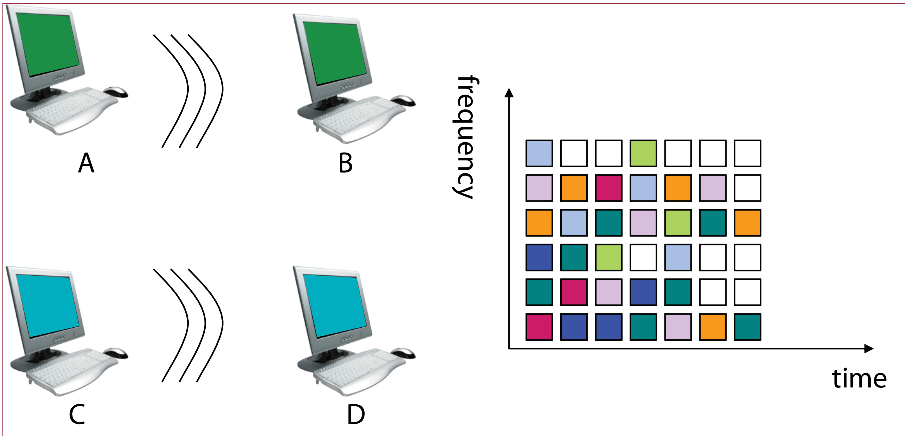


Figure 3.19

Spread spectrum. Radio networks share the scarce airwaves by breaking communications into small packets that are sent at different frequencies and time slots. In a given time slot, if one frequency is not available, the transmitter shifts to the next frequency. If all frequencies are being used, the transmitter must wait for the next time slot.

cies so they could be simultaneously transmitted across expensive long-distance lines.

With a little more thought—and a focus on packets—you will see that it is possible to combine both frequency and time division into **direct spread spectrum (DSS)**. As an interesting historical footnote, the original patent for the technique was granted to actress Hedy Lamar and composer George Antheil in 1942, during World War II. Hedy recognized that a piano-roll mechanism could be used to shift radio frequencies at random to prevent opponents from intercepting or jamming radio transmissions.

Figure 3.19 illustrates the process. When a computer or cell phone wants to transmit a packet, it checks for an open frequency slot. At each time interval, that frequency might shift, so the receiving computers listen to all available frequency slots and check the destination addresses of each packet. Today, the key benefit lies in its ability to fully utilize the available bandwidth. Allocating fixed frequencies to everyone is inefficient because many of the frequencies will be unused at any point in time. Splitting the communication by time and frequency enables each transmitter to choose any available open frequency. Remember that communication frequencies are tight in every nation. Yet, researchers have shown there is plenty of bandwidth available—if all transmissions were converted to spread spectrum. Because of the technical and political issues, this change is unlikely to happen soon. However, almost all new applications use spread spectrum technologies within a defined frequency range.

One cellular phone manufacturer (Qualcomm) invented a radically new method of sharing a communication medium. Today, the Verizon network uses this technique to provide high-speed voice and data communications to its cell phone customers. Newer proposals for cell phone networks have discussed using similar technologies. The method begins with DSS, but every transmission also incorpo-

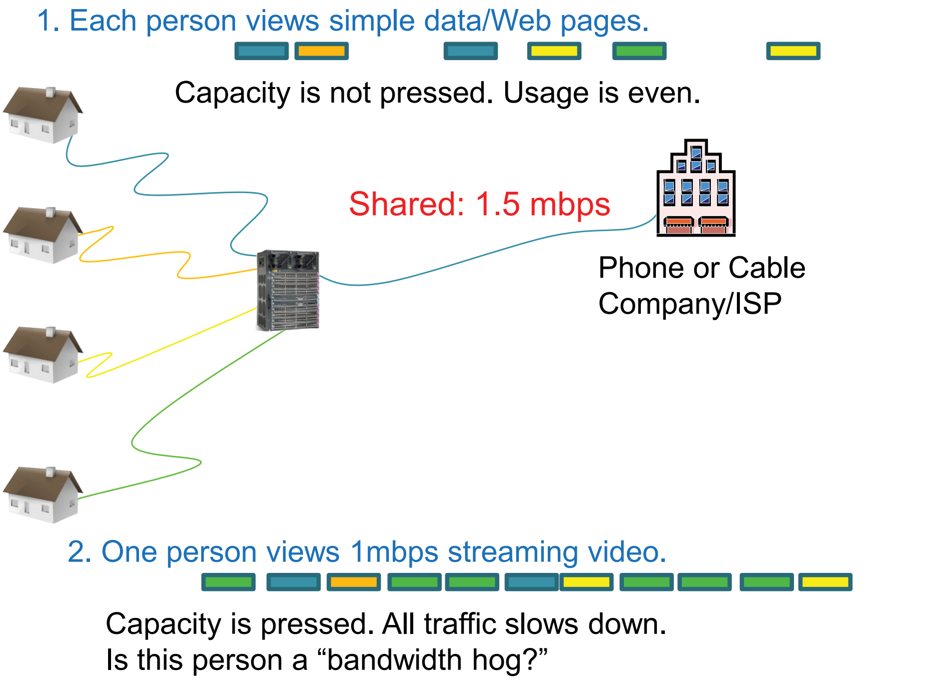


Figure 3.20

Managing shared networks. Some network applications use significantly more bandwidth or capacity. If a small number of advanced users eat up the shared capacity, does that make them bandwidth hogs?

rates a unique ID code. By adding some mathematical calculations to every device (including the cell phone), multiple devices can transmit at the same time on the same frequency—using the math to recover separate data packets. This code-division multiple access (CDMA) method is efficient, but patent and licensing battles have made other providers reluctant to adopt it.

Managing Shared Networks

As the number of users increase on a network, it is likely that the network will encounter congestion problems. For example, the AT&T cell phone network was widely criticized when it was the sole provider of the Apple iPhone. In some major cities including New York and San Francisco, many users reported problems with dropped phone calls. Similar problems can happen with any shared connection when traffic reaches the bandwidth capacity. For example, most cell phone networks face problems if a major crisis hits a particular location and thousands or millions of people all try to use their phones at the same time. Related problems happen with data networks. Most Internet providers provide data capacity based on the "typical" usage rates. For example, as shown in Figure 3.20, an Internet connection might have a data capacity of 1.5 mbps, and that line might be connected to 10 households. As long as each household uses typical Web browsing at random times, the data will transmit quickly enough that interference will be low and users will mostly see the full transfer rate. But, what happens if three

Reality Bytes: Video Traffic from NetFlix Dominates the Internet

For many years, peer-to-peer file sharing dominated the traffic flow on the Internet—particularly in the United States. Many people used BitTorrent to exchange large data files—particularly video, and often illegally. By May 2011, NetFlix, with its online subscriptions, had taken over the number one position in terms of total data transferred on the Internet. The traffic account for 22.2 percent of all U.S. broadband traffic. BitTorrent was still a close second at 21.6 percent. The percentages are based on the actual usage or volume of traffic, not on the bandwidth capacity. The main reason for the increase is the relatively low price of $9 per month for a subscription. Experts estimate that it costs NetFlix between 2-10 cents to deliver a movie online, based on server and bandwidth costs. The licensing costs are higher but the exact cost is not available.In some ways, today's Internet business world is like the early days of business—you simply did not trust anyone you did not know. As economies grew, states learned to control fraudulent businesses by requiring them to register. Today, legitimate businesses are registered with at least one state government and must file annual forms and provide legal contact information. Most of this data is accessible online. Is it really any different to require people to file legitimate contact information for online registrations?

Adapted from Ryan Singel, "Most Content Online is Now Paid For, Thanks to Netflix," *CNN Online* (Wired), May 18, 2011.

users start watching hours of streaming video that requires 500 kbps per person? These three people will effectively use up the entire capacity of the shared line. Streaming video can be a problem on many networks. The BitTorrent data transfer program can also be a problem because it tries to utilize as much bandwidth as possible and is often used to transfer huge files.

Internet and cell phone providers (along with your university network managers) have faced congestion issues for years. As new network applications have emerged—particularly video—the capacity demand has continued to increase. In any shared network, some early adopters are likely to use the new applications more than other people. Consequently, their bandwidth or capacity usage will be higher than other users. Is that bad? Some commercial networks have approached the problem by labeling them **bandwidth hogs** and imposing penalties for anyone who uses the network more than others.

Managing a commercial network is more complicated than it appears—and it already seems hard enough. In addition to installing lines and keeping the network switches and routers running, the commercial providers have to determine pricing and find ways to encourage people to choose their network, yet keep costs low enough to earn a profit. And that does not begin to deal with any of the security issues covered in Chapter 5. To obtain customers, many companies offered "all-you-can-eat" data plans for a fixed monthly fee. But, new applications were developed including video, large-file sharing (BitTorrent), and Web video conferencing; and these new applications require considerably more bandwidth than simple e-mail and Web browsing. Some people adopted the new applications quickly, with the potential to cause congestion for everyone. Ideally, network companies would expand their capacity and provide higher speeds for everyone—but that increases costs, and some people are likely to consume bandwidth no matter how much is available.

- Prioritize Traffic
  - Slow down some users—perceived hogs.
  - Slow down based on type of traffic.
    - . Packeteer—examine packets to identify.
    - . Connection port (rare).
  - Sell quality of service (rare yet).
- Pricing Mechanisms with Data Caps
  - Overage fees.
  - Differential pricing.
  - Time-of-day pricing (rare yet).
  - Potential problems as speed increases (4G cell).
    - . Medium quality is at least 1 GB/movie.
    - . Common data cap of 5 GB/month.
    - . At 5 mbps, 5 GB cap reached in 133 minutes.
- "Net Neutrality" Proposal
  - What if a commercial network tries to slow down traffic from a competitor?
  - Example: Comcast owns NBC (2011/01)
  - But can "neutrality" be defined to still allow networks to manage traffic?

Figure 3.21

Options for managing network traffic. Commercial networks are trying several methods to reduce the congestion caused by advanced users. Prioritizing certain types of traffic can be a good solution, but it could also be abused. Pricing based on usage makes the most sense economically, but it can be harder to implement and harder to sell to customers.

Figure 3.21 outlines some of the options available to manage traffic on networks to reduce congestion. Most commercial and university networks use a combination of the choices. In some ways, prioritizing traffic can be the most neutral. Network devices can monitor the type of data carried by each packet and determine how quickly to send the packet. High-bandwidth, low-value packets are delayed when network usage is high. For example, e-mail is often given high priority, while online games and file sharing are given low priorities. The packets eventually get delivered, but users of those applications see substantially slower data rates. A few providers have implemented plans to reduce the data speeds for specific users. Once a person exceeds a certain amount of data transfer for the month, their future usage will be slowed down for a month.

Cell phone providers have become the most creative in terms of pricing. An economist would observe that congestion pricing mechanisms are more efficient than arbitrary limits. The catch is that marketers want to sell phones and services by offering more open-ended plans, and customers get nervous about data caps. Most vendors have implemented simple tiered data plans, where customers pick a plan by estimating monthly usage levels.

However, data caps are often set relatively low and they can be easy to exceed. For example, consider a monthly cap of 5 gigabytes (GB). Then consider a 4G cell phone that can download data at 5 megabits per second. That phone would hit the data cap after only 133 minutes—or about one high-quality movie. (Calculation: 5 billion Bytes * 8 bits/Byte / 5 million bits/second / 60 seconds/minute).

Before you make any hasty decisions about the managers of networks, think about the problem from a business perspective for a minute. What happens to the network if ten people want to stream a movie at 5 mbps at the same time? Effectively, that generates 50 mbps demand. How much capacity can be built into the network? What if 100 people do the same thing? That amounts to 500 mbps simultaneous demand. How are you going to build a network that can handle that level of traffic? And you are still looking at only 100 people on the network. Digitized voice is only 64 kbps, so the high-definition movie takes about 80 times the bandwidth as a phone call. Either you need a massive increase in network capacity or some way to discourage people from using high-bandwidth applications. Although, you might want to talk to the marketing people about toning down the advertising telling people they can watch movies on their cell phones.

Standards

How is it possible that you can connect your computer to a network at the office, at home, or while on the road, even overseas? Standards are agreements among vendors, customers, and nations. If everyone follows the standards, equipment can be connected, data can be shared, and you can connect your computer to the network anywhere in the world. But evolving technologies and competition significantly complicate these tasks. Setting standards and moving to new ones is always a challenging task. However, the Internet exists because of standards.

The Need for Standards

Standards are important with networks. Many different types of computers and connection devices exist. Each computer and network company has its own idea of which methods are best. Without standards, there is no way to connect computers or networks produced by different vendors. Standards are also supposed to protect the buyers from obsolescence. If you install network equipment that meets existing standards, you should be able to buy products in the future that will work with it.

Unfortunately, the process is complicated because several standard-setting organizations exist. Each major country has its own standards organization such as ANSI, the American National Standards Institute, plus several international organizations exist, such as ISO and the ITU (International Telecommunications Union, renamed from CCITT), charged with defining computer and communication standards. In addition, manufacturers of computers and telecommunications equipment try to define their own standards. If one company's products are chosen as a standard, it gains a slight advantage in design and production.

It is not likely that typical managers will be involved in the issues of setting and choosing communication standards. Yet, as a consumer, you need to be aware that there are many standards and sometimes variations on the standards. (In this industry, a standard does not mean there is only one way to do something.) When you are buying telecommunications equipment, the goal is to purchase equipment that meets popular standards. It is not always easy to decide which standards will become popular and which ones will be abandoned.

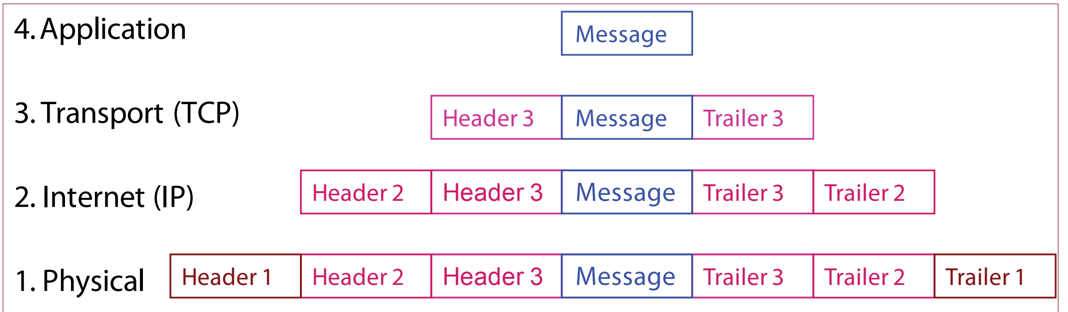


Figure 3.22

TCP/IP reference model. The model illustrates how data from an application like e-mail is turned into packets at the transport layer, routed to the destination at the IP layer, and physically transferred as bits at the physical layer.

A Changing Environment

Why are there so many standards? It would be far simpler if everyone could agree to use one standard and build products that are compatible. The problem with this concept is that technology is continually changing. Thirty years ago, phone companies never considered using digital transmission over fiber-optic cables, which is the dominant form of long-distance transmission used today. When the Internet was first created, the technology of the time would not handle the billions of addresses we need today.

As each technology is introduced, new standards are created. Yet we cannot discard existing standards because it takes time for firms to convert to the new technology. Besides, as manufacturers gain experience with a technology, they add features and find better ways to use the products. These alterations usually result in changes to the standards. An additional complication is that many companies are modifying their products at the same time. It is hard to determine in advance which changes are worthwhile and should be made standards.

The net result is that standards can be useful, but managers have to be careful not to rely too much on a standard. First, remember that even if two products support a standard, they still might not work well together. Second, if you choose a standard for your department or company, remember that technology changes. Corporate standards should be reevaluated every year or so to make sure they are still the best solution. Global standards are required to ensure compatibility of networks and efficient routing of data.

Internet TCP/IP Reference Model

The Internet transmission protocol standard is an important standard. It also helps you understand how networks operate and how the Internet works. As shown in Figure 3.22, the TCP/IP (transmission control protocol/Internet Protocol) reference model breaks the process into four layers: application, transport, Internet, and physical. Breaking the process into separate layers is critical to building large networks. Each layer can be handled independently of the others. For example, at the physical layer, replacing a wired connection with a wireless one should not affect any of the higher layers. The physical layer devices simply have to provide the same functionality to the Internet layer.

Technology Toolbox: Transferring Files on the Internet

Problem: You need to transfer data files to a Web site.

Tools: It is relatively easy to transfer files from your computer to another computer connected on a local area network. Assuming that you have the proper security permissions, you can see the other computer as if it were another disk drive and drag-and-drop the file. But no company is going to open its network to allow you to do the same thing across the Internet. So, how do you transfer files to a Web server if it is not located on your LAN?

Connection	Strengths	Weaknesses
FTP	Inexpensive and easy to use.	No security.
FrontPage	Very easy to use with secure login.	Limited availability and users have to purchase client software.
WebDAV	Internet standard and can be secure.	Web server security is weaker by allowing directory browsing.
VPN	Very secure.	Need to purchase server and client software and requires extra setup steps.

Surprisingly, given how frequently people need to transfer files, this question does not yet have a good answer. An older method still in use is the file transfer protocol (FTP). Your Web browser probably supports drag-and-drop with ftp. You can enter an address like ftp://myserver.com/www, and the browser will connect and display a list of files in the folder. Then you can drag-and-drop your files or an entire folder onto the folder window and it will be transferred to the server. The drawback to FTP is that passwords are sent in the clear and might be intercepted by hackers. Most companies today require that you transfer files using secure FTP tools that automatically encrypt login and file data. These systems require your client computer to have special software that matches the server's encryption.

The Internet community has developed the Web distributed authoring and versioning (WebDAV) service to help solve the problems of sharing files. As an open standard, it is available on many servers. If you have an account on a server that has WebDAV enabled, you can use the Internet Explorer to connect and transfer files. Just be sure to use the File/Open command, enter the name of the site, and check the box to "Open as a Web Folder." WebDAV is an extension of the HTTP protocols, so it supports secure login and can take advantage of common encryption tools.

The other approach to transferring files to a corporate server is to establish a virtual private network (VPN) connection first so that all communications are encrypted. Then you are free to use FTP or any other common protocol inside the VPN tunnel because no one can intercept and decrypt the messages. But you need control over the server or a special server to configure VPN.

Most hosting companies use Web file uploads, which can be secure if Web security is installed on the server. But, transferring files has been cumbersome and generally only one file can be uploaded at a time. The new HTML5 definition might improve this process because it supports file upload with a drag-and-drop feature built into the browsers.

Quick Quiz:

1. Which methods can you use to transfer files to a university server?
2. Why is FTP considered a security threat?
3. What other objections exist to FrontPage?

Notice that moving down, each layer takes the data from the prior layer and adds header and trailer information. This additional data is necessary for each layer to perform its function, but it means that more data must be transferred. For example, even if your physical connection can transmit data at 10 mbps, a 10-megabit file cannot be transferred in one second. Depending on the application and the network details, the overhead from the layers can be 20 percent or higher.

Note that there is a competing seven layer network model that defines the ISO-OSI view of networks. The model is similar in concept to the TCP/IP model, but it breaks level 1 into two layers, and level 4 into three layers. Since this is not a networking book and the Internet protocol dominates, there is no reason to cover it here. You can find details on the Internet if you ever need them.

Subnet/Physical Layer

The purpose of the subnet or physical layer is to make the connection between two machines and physically transfer bits of data. It is directly related to hardware. Standards exist to specify constraints on voltage, type of wire, frequency of signals, and sizes of physical connectors. Raw data bits are transferred at this stage. Many different technologies exist, including wireless, wired, and fiber-optic lines.

The network interface card is a critical component of the physical layer. In addition to handling the data transfer, each card has a unique **media access control (MAC)** address. This address is a globally unique number that is assigned to the card by the manufacturer. Switches use this number to identify every device on the network and send packets to the correct device. In fact, the technical difference between switches and routers is that switches work at Level 1 and routers at Level 2.

Internet/Network Layer

The Internet layer is concerned with routing messages to the appropriate location. In particular, it selects the appropriate path for a message in networks where there is a choice. Its main advantage is that it separates the higher layers from the physical transmission of data. The network layer handles connections across different machines and multiple networks. The Internet Protocol (IP) is the standard used in routing packets on the Internet network. With IP, each packet is treated independently of the others and each can follow a different route to the destination. Each machine must have a globally unique address, so a mechanism is established to assign numbers to machines. It would be difficult to use the physical MAC addresses because they are randomly assigned. A logically assigned IP address is better because the number can be used to help route each packet by using portions of the number to segment the network. Plus, if you need to change a physical network card, you can keep the same IP address and the Internet will continue to function correctly. The current version of IP (IPv4) uses a 32-bit address, which is beginning to cause some problems because IPv4 supports a maximum of about 2 billion addresses, and the world is beginning to run out of numbers.

The newer IPv6 standard supports 128-bit addresses, but it will take time to phase in the new system. Newer servers and operating systems support the IPv6 protocol, but it will take time to update all of the routers on the Internet. In the meantime, most companies are using intermediate steps to allocate the IPv4 numbers. Windows 7 automatically activates IPv6 alongside IPv4 so it can support both types of connections.

Reality Bytes: NEC Lab Sets Fibre Speed Record

In March 2011, NEC Laboratories in Princeton, New Jersey announced they had pushed more than 100 terabits of information per second through a single optical fiber. That amounts to transferring roughly 250 dual-layer Blu-ray discs in one second. Tim Wang from the Lab noted the feat marks "a critical milestone in fibre capacity." By comparison, Tim Strong of Telegeography noted that total capacity between New York and Washington D.C., one of the world's busiest Internet routes, is only a few terabits per second. But, he also noted that traffic has been growing by about 50 percent per year. Typically, optical fiber capacity is increased by splitting transmissions into multiple frequencies—or colors. Additional capacity can be gained by using different polarities, amplitudes, and phases of light. Dayou Qian of NEC reported sending 101.7 terabits per second through 165 kilometers of fiber. His team used 370 separate lasers and several kilowatts of power to accomplish this feat. At the same conference, Jun Sakaguchi of Japan's National Institute of Information and Communications Technology in Tokyo also reported reaching 100 terabits per second. His team used a special fiber with seven internal light-carrying cores. Using a completely different method, Wolfgang Freude and his team at the Karlsruhe Institute of Technology in Germany achieved transfer rates of 26 terabits per second—using a single laser. Although somewhat slower than the 100 terabits record, the cost of implementing Freude's method is substantially lower. His team used orthogonal frequency division multiplexing (multiple colors) and a fast Fourier transform to separate the colors on the receiving end. Each color arrives at slightly different times and the process could be embedded onto a silicon chip.

Adapted from Jeff Hecht, "Ultrafast Fibre Optics Set New Speed Record," New Scientist, April 29, 2011; and Jason Palmer, "Laser Puts Record Data Rate Through Fibre," BBC Online, May 22, 2011.

Transport Layer

The transport layer is responsible for dividing the application data into packets and providing logical connections to the network. The transport control protocol (TCP) is commonly used on the Internet to handle these connections. TCP supports multiple applications at the same time by creating numbered ports. For example, e-mail is usually transferred through port 25, and Web data through port 80. TCP sends the data packet to the specified port on the desired machine. TCP on the host machine listens to these ports and sends the incoming data to the appropriate application server. TCP also monitors the packets to see if any are lost in transmission. If so, the recipient machine can request that the missing packet be re-sent, providing a highly reliable connection between two machines.

The Internet also supports the user datagram protocol (UDP), which is a highly simplified transport method. Most important, it does not guarantee that a packet will be transferred. Generally, users do not get to choose between TCP and UDP. This choice is made by the software developer at the network level. But why would anyone choose UDP when there is no assurance that the packets will be delivered? The main reason is speed. Because UDP is so simple, it adds only a tiny overhead to each packet, which makes it useful for large transfers of data, such as large files and streaming multimedia. If necessary, the application can check at the end to ensure that all data was transferred.

Application Layer

The application layer consists of tools and services for the user. Typical Internet applications include e-mail, file transfer (FTP), and Web browsing with the hypertext transfer protocol (HTTP). These systems work because developers have agreed to follow basic standards.

With the TCP/IP reference model, applications are responsible for incorporating authentication and compression. Not having a standard underlying method for handling security has caused some problems with TCP/IP. Few applications actually have any security, several incompatible variations of security systems have been created, and hackers have been able to write programs that attack the underlying, unprotected layers. Security is one of the main problems being addressed in IPv6 and Internet2.

The Internet

What is the Internet, how is it controlled, and how does it work?

The Internet is a loose collection of computer networks throughout the world. It began as a means to exchange data among major U.S. universities (NSFnet of the National Science Foundation) and connections to various military organizations and U.S. defense suppliers (Arpanet of the Advanced Research Projects Agency). No one knows how many computers or networks are currently connected by the Internet. The numbers have been increasing exponentially since the early 1990s, so any number is likely to be wrong within a few days. To give you some idea of the Internet's astounding growth, in January 1993, there were 1.313 million host computers. In January 1994, there were 2.217 million hosts located in more than 70 countries. In 2000, Telecordia estimated that the Internet had exceeded 100 million hosts. By 2007, Internet Systems Consortium counted over 400 million host computers. Billions more people connect to these hosts using computers, tablets, cell phones, and so on. In 1994, over 20 million people had access to at least e-mail services. As of mid-1994, commercial use (as opposed to university and government use) accounted for 50 percent of the Internet usage. By 2004, over 500 million people worldwide had access to the Internet. Measuring the Internet is difficult, since machines are not always connected. Most studies use some type of survey to estimate the size. However it is measured, usage of the Internet continues to grow.

What exactly is the Internet? At heart, the Internet is just a communication system for computers. It is defined by a set of standards that allow computers to exchange messages. The most amazing aspect of the Internet is that there really is no single person or group in charge. Anyone who wishes to connect a computer to the Internet simply agrees to pay for a communication link—via an Internet service provider (ISP)—and to install communications hardware and software that supports the current Internet standard protocols. The person or company is given a base address that allows other computers to identify users on the new computer. Standards are defined by a loose committee, and addresses are controlled by another small committee. The committees are convened purely for the purpose of speeding the process; all decisions are up to the organizations connected to the network. Participation in the Internet is voluntary, and there are few rules, just standard practices and agreements. From a business or consumer viewpoint, there are two primary aspects to the Internet: establishing a connection and using the Internet.

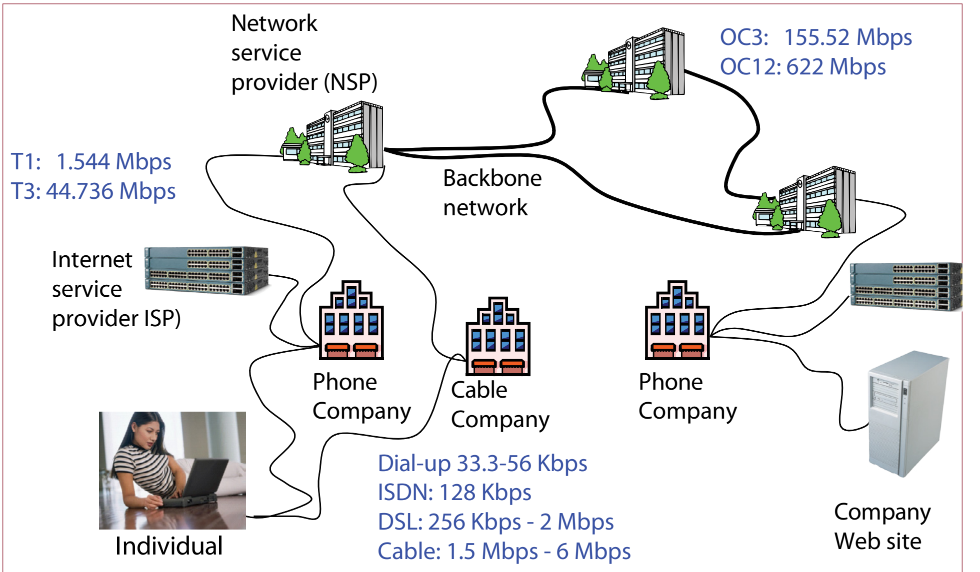


Figure 3.23

Internet connections. Each computer must be connected to others. The Internet has a connection hierarchy. Companies and individuals typically use phone company lines to connect to an ISP. The ISP connects to an NSP, which routes data over the high-speed backbone network to the destination NSP, down to the other ISP, and to the final computer. Each step may involve several computers.

How the Internet Works

The Internet is a communication system; it is a method of connecting computers together. So the first step in determining how the Internet works is to understand how your computer connects to others. As shown in Figure 3.23, the Internet has a hierarchy of service providers. Individuals pay a local **Internet service provider (ISP)** for access to the Internet. In turn, local ISPs pay an upstream network service provider (NSP) for access to their systems and features. Each connection must be made over a communication link. Local links are typically made over telephone wires, but cable companies also provide service over their coaxial lines. A few companies provide satellite connections. Some wireless providers exist, but availability, features, and pricing vary by location. Most ISPs also utilize phone company lines to connect to their NSP, but they lease dedicated, full-time lines that provide faster service. The largest NSPs (Tier 1) also provide backbone service. That is, they route communications over their own fiber-optic lines that are installed across the United States. Increasingly, NSPs are also phone companies. Some started as phone companies and expanded into the Internet; others started with the Internet and gradually offered voice services.

If you search for an ISP or look at the market for Internet connections, you will find several providers using different technologies. The Internet backbone has been relatively stable for several years, but the industry battles have been taking place in the **last mile** of the Internet—building connections directly to customers. The primary providers have been the local phone company and cable TV providers. They are important because they have existing lines into customer houses

Backbone Providers		Network Service Provides	
AT&T	Sprint	AT&T	Qwest
Level 3	MCI (UUNet)	Cable & Wireless	Sprint
Qwest		IBM	MCI
Phone Companies		**Cable Companies**	
Regional Bell operating companies (3 RBOCs)		Comcast	
Competitive local exchange carriers (CLECs)		Cox Communications	
		Regional	
Leading ISPs		**Satellite**	
AT&T		Direct Satellite	
Comcast		Wild Blue	
Verizon		Starband	
America Online			

Figure 3.24

Leading Internet providers. There are thousands of ISPs and cable companies. This list provides only some of the large companies in each category.

and businesses. Some technical differences exist between a digital subscriber line (DSL) and cable modem broadband connection, but ultimately customers make a choice based on availability and secondary considerations. For example, both tend to require that you purchase additional services, such as local phone service or cable-TV. The electricity industry has also been trying for several years to enter the ISP market—because they provide the third set of wires into households. However, transmitting data over noisy (and old) power lines has presented many technical obstacles. In 2006, the industry claimed to have found reasonably low-cost solutions, but it is not clear that the industry knows how to compete with the other providers. A few cities (and companies such as Google) have attempted to cover entire cities with WiFi Internet access—effectively offering free Internet connections. However, WiFi access points have a limited range of a few hundred feet. Although each access point is relatively inexpensive, it costs money to run cables to all of the points needed to cover a wide area.

A greater challenge to the dominance of the phone and cable companies is wireless access via fourth generation (4G) technologies. Sprint was the first to market with WiMax service provided by Clear. In late 2010, Verizon began offering their 4G cell phone service long-term-evolution (LTE). With few users and minimal congestion, early adopters reported speeds of 6-10 mbps for downloaded data. Upload data rates are substantially slower—even less than 100 kbps in many cases. But with these numbers, cell phone service might be usable as a full-time Internet connection. In fact, most companies sell WiFi add-on services that enable cell phones to operate as WiFi access points—providing Internet access to nearby computers and tablets.

You should understand the foundations of the Internet, because someone has to pay for each connection. Current pricing policies are to charge for the initial communication link and for the point-of-contact Internet service. For example,

General Data Centers	Specialty Hosting Companies
Equinix Cybercon Savis Telecity (Europe)	IBM AT&T EDS Thousands of small, regional providers

Figure 3.25

Leading data center providers. The general data centers simply provide space, electricity, cooling, and high-speed Internet connections. The specialty providers usually sign contracts to provide individual services.

an individual pays the phone company for the local phone line and pays the ISP for basic services. The ISP pays the phone company for the next link and pays the NSP for access services. Figure 3.24 lists some of the largest providers in each category. You can check with them for current prices and services.

The charging mechanism is similar for companies that wish to establish Web sites. The catch is that the costs are higher because the company needs faster communication services. The phone company charges more money for a faster link (e.g., $500 to $1,000) per month for a T1 line). The ISP also charges more money for the increased traffic because it needs faster equipment and faster connections to the NSP.

The Internet service connection business is completely based on economies of scale. The high-speed fiber networks (OC3 and OC12) can handle a vast number of transmissions, but they carry a high fixed cost. The backbone providers make money by selling smaller increments of bandwidth to the ISPs, which incorporate a sufficient profit. Many of the NSPs are backbone providers and increasingly they also offer ISP services.

Video and Heavy Use Complications

The problem of video is relatively complex. Perhaps you have a high-speed Internet connection and could receive high-quality video, say 1 mbps. But, think about what will happen if as few as 100 people try to view that same high-resolution video at the same time. The provider's server has to stream 100 copies of that video simultaneously—eating up 100 mbps. Hence the server (such as YouTube) needs to have at least an OC-3 Internet connection at $20,000 per month just to handle 100 simultaneous viewers. The same problem can arise if millions of visitors suddenly find a new Web site—as happens when a national radio or television program highlights a site. How is it possible to handle that much traffic?

One answer is that several specialty hosting companies have evolved with massive Internet connections. They have built data centers with multiple OC-48 (or better) Internet connections. You can contract with them to **co-locate (colo)** your servers in their buildings. For a monthly fee, they provide the space, power—with UPS, and air conditioning, along with the high-speed Internet connection. Figure 3.25 lists some of the biggest providers with multiple data centers. Larger companies might contract directly with these firms; smaller companies will work through intermediaries who already have co-location arrangements with these companies. The specialty providers, such as IBM, tend to be more expensive and negotiate individual contracts to perform specific jobs.

Even if you have a high-speed connection to the Internet, it is still difficult and expensive to handle thousands or millions of Web site visitors. A second answer is provided by Akamai, a company that was created specifically to reduce the load on Internet servers. The company has installed thousands of servers in over 70 countries that hold duplicate copies of your content. As shown in Figure 3.26, individual users automatically retrieve data from the nearest server. Users see only your site but get a faster response. More importantly, the load on your company's server and Internet connection are significantly reduced because the individual requests are handled at multiple points. Distributed network servers are the only way to handle the distribution of video content, because even a few hundred users could overwhelm the network capacity of a single server. Amazon provides a similar service that smaller companies can use for smaller tasks. This service (S3) is described in more detail in Chapter 7.

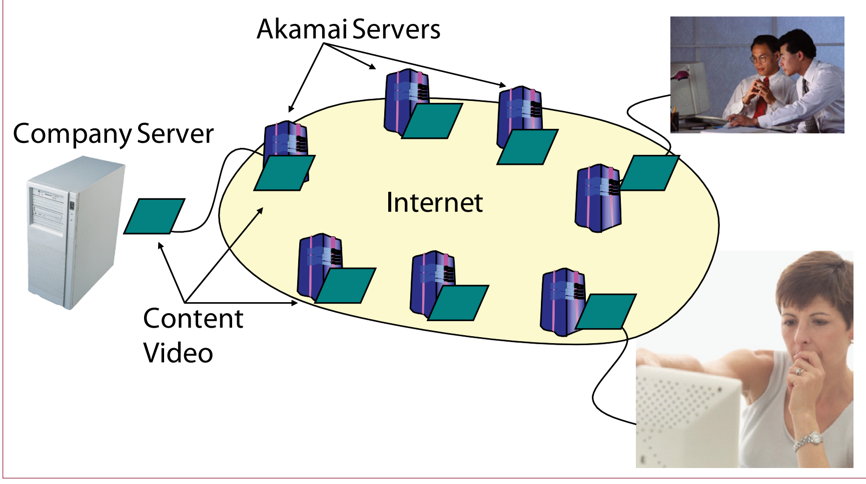
Broadcast streams are slightly different from simple video files. You might have an event that you want to broadcast to multiple users at the same time—such as a ball game. Your server could generate a single feed, and this feed could be duplicated and split to thousands of users. If handled correctly, your server and Internet connection generate only a single data stream. This stream is then split and duplicated at routers along the way to multiple clients. Some companies, notably MLB, are working on these technologies, but problems still arise when too many people access the streams.

Telephones and The Internet

All phone calls today are converted to digital signals and sent over a network. So, why should you pay for long distance phone calls? Of course, most people have cell phones which rarely charge extra for long-distance calls within a country. But, they still use plan minutes and generally require higher payments for international calls. You already pay a fixed monthly fee for Internet access, and the Internet is

Figure 3.26

Distributing content through Akamai. By distributing your content to servers at the "edge" of the Internet, customers retrieve data from multiple points, reducing the load on your server and Internet connection.



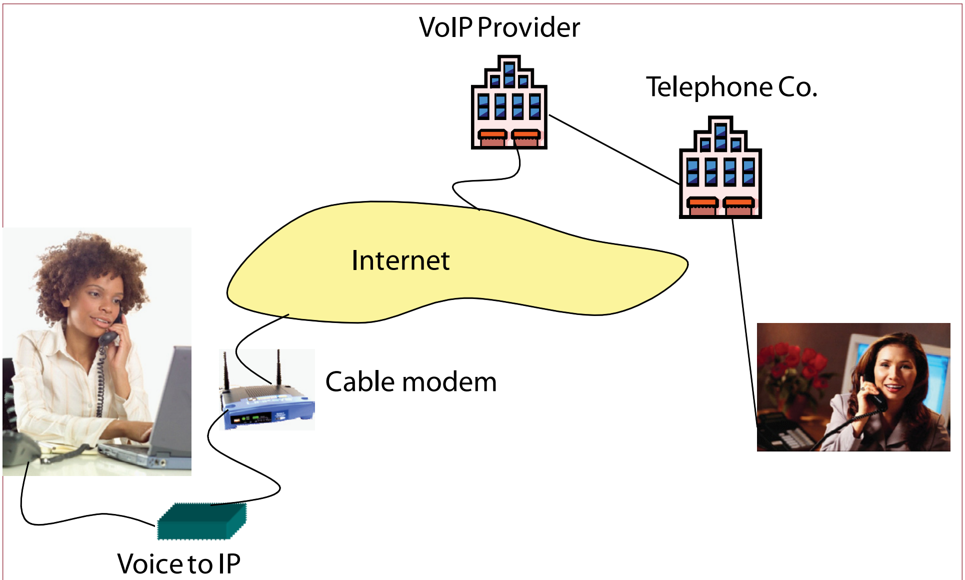


Figure 3.27

Voice over IP. The phone, or a separate device, digitizes the voice and sends it as IP packets on the Internet. A third-party company converts the Internet packets back to telephone packets and sends them across the phone network.

worldwide, so you could just use the Internet connection to handle voice calls. **Voice over IP (VoIP)** is a technology that converts your phone call directly to Internet packets and ships them to the destination. The technology is straightforward and relatively inexpensive. However, Figure 3.27 shows an important complication. To use your VoIP phone to connect to people with regular or cellular phone service, you have to contract with a company that can convert the Internet packets back into the plain old telephone system (POTS). The process is particularly effective for international calls because the Internet packets can be converted as close as possible to the destination—avoiding international and long distance charges. In the U.S., Vonage played that role until 2007 when Verizon, one of the phone companies, won a major patent-infringement case against Vonage. The phone companies were already pressured by the consumer switch to cell phones; losing long-distance revenue to third-parties like Vonage presents a major competitive threat. On the other hand, if the person you wish to call has Internet access, you can simply use a direct PC-to-PC connection and skip the phone company and third-party completely. If you can directly connect to the other computer, you can use voice or even video connections for no additional charge—anywhere in the world. Skype is a newer company that now dominates VoIP calls—partly because they offer free calls for computer-to-computer access, including video chat if you have Web cameras. Skype also offers relatively inexpensive monthly fees even for international calls to land lines and cell phones. You can even get your own phone number for your Skype/computer account.

Reality Bytes: More Data More Speed

Check any wireless indicator and it is obvious that many households have installed wireless routers. Wireless access is popular for almost all computers, both for homes and businesses. The initial wireless transfer rates were only 11 mbps on the 802.11b standard. Then the 802.11g standard was created to support 54 mbps transfer rates. After a few years and some arguments over technology, the 802.11n standard supported a top rate of 450 mbps. Although 802.11n routers are widely available in 2011, most operate at about a third of that peak speed or about 150 mbps. All transmission methods have overhead and do not actually transfer data at the peak rates. Typically, 10 percent or so is used for overhead such as packet identifiers and addresses. But, wireless is relatively inefficient, more often operating at 70 percent of the peak transfer rates. Rates are even lower when multiple devices are heavily using the same router. But, technology development continues. The 802.11ac standard defines transfer rates of 1 gigabit per second (gbps) and the 802.11ad standard will support a peak rate of 7 gbps. Both are expected to reach the market in 2012 or 2013. The new technologies will probably operate in the 60 GHz frequency band, compared to the 2.4 GHz band used by older devices. This range provides more data capacity, but the radio waves do not travel very far and are absorbed by walls, trees, and water. Why would anyone need such high transfer rates? The simple answer is: video. The 7 gbps speed is fast enough to transfer uncompressed high-definition video. Which means almost all devices could operate without wires. Wireless does have a problem with latency—the delay between sending a signal and receiving a response. Latency is not an issue with movies or basic displays, but it does cause problems for games or similar interactions, where responses need to be almost instantaneous.

Adapted from Stephen Shankland, "Coming to a Network Near You: Faster Wi-Fi," CNet News, May 31, 2011.

Internet Addresses

In any network, each computer must have a unique address. At the local level, network cards contain a **media access control (MAC)** address. This number is used by switches to route local traffic. On the Internet, every computer is assigned a logical IP number.

Currently, these addresses are 32-bit numbers, typically written as 4 bytes separated by dots. For example, your machine might be assigned 138.9.15.2 as an address. However, 32-bit numbers will identify a maximum of 4 billion machines. In practice, perhaps 80 percent of those numbers are usable because some values cannot be assigned and others are assigned in bulk to companies but not in use. Hence, an Internet committee designed a new numbering system consisting of 128 bits, which allows for several millions of numbers to be assigned to every person likely to live on the planet. The new system is known as **IPv6** and is being phased in gradually.

Servers need to be assigned IP addresses that do not change, or seldom change. Client computers can be assigned numbers from a local router or computer using the **dynamic host control protocol (DHCP)**. The DHCP server has a pool of address numbers and gives one to each computer as it connects to the network.

In most organizations, the process of assigning addresses is more complex. Large companies and universities were the first to encounter problems with the

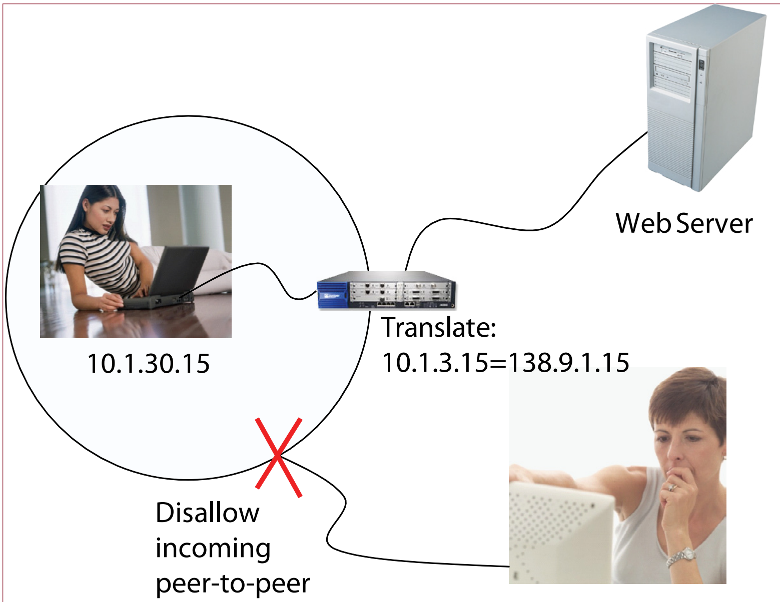


Figure 3.28

Network address translation. Internally, machines are assigned numbers that cannot be used outside the local network. Requests sent to external servers are temporarily assigned a real IP address by the router. Any external attempt to reach an internal computer is automatically blocked.

limited number of IPv4 addresses. Consequently, they purchased Internet routers that implemented **network address translation (NAT),** which is commonly used by businesses and even home users today. As shown in Figure 3.28, with NAT, your house (or office) might be assigned one Internet address that connects to a router. The router then assigns completely different numbers to all of the machines in the home or office. When a local computer requests a page or service from the Internet, the router tags the address so it can identify which machine made the request. All replies are returned to the same port, and the router directs the connection to the original machine. Essentially, the router translates or changes the internal addresses into the single external number. Client computers are assigned internal IP numbers that cannot be used outside the NAT. Typically they start with 10 or 192.168. Essentially, one real IP address is multiplied to work with several local devices.

NAT also creates an additional security level because no one outside this local network can directly access any of the computers. However, sometimes you actually want to connect to other computers. In particular, it causes complications if you want to use groupware or peer-to-peer systems across the NAT router. If you and the person you wish to contact are both running computers behind different NAT connections, you will not be able to make a direct connection. In this situation, you will need the use of a third-party server. Cisco WebEx and Microsoft LiveMeeting perform this role for online conferences. Skype performs this function for voice phone calls that use the Internet, and SlingPlayer does the same for watching television remotely. Both parties first establish a connection to the serv-

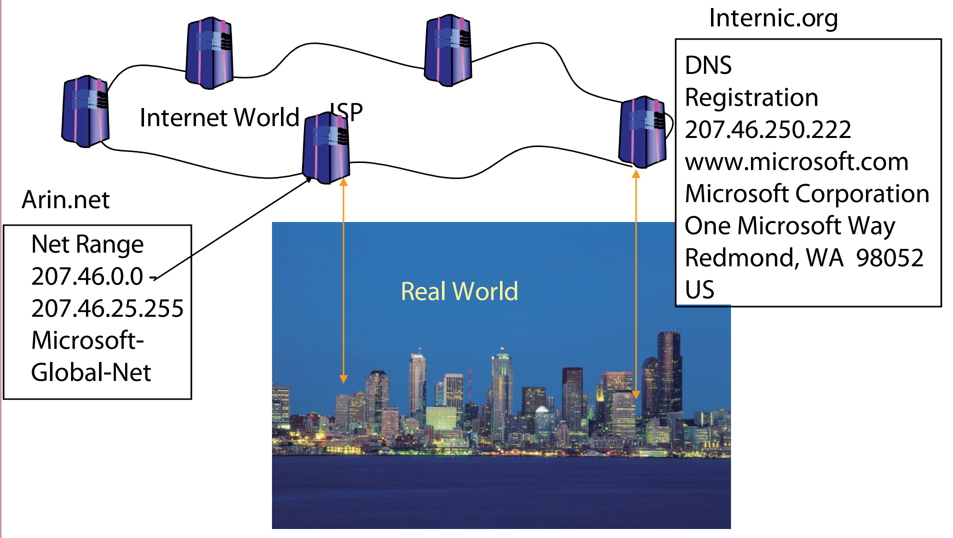


Figure 3.29

Domain Name Registration. Internet entities are anchored to the real world through the DNS registration and their ISP. But, some firms lie in their registration, and some ISPs are controlled by unethical people.

er. The server has a fixed IP address, grabs the currently-assigned IP addresses of the two parties and connects them to each other. Companies can also run in-house servers with fixed IP addresses to handle the initial connection. Using in-house computers is more secure because the communications do not have to go through a third party.

NAT also makes it considerably more difficult to track down individual users on the Internet. If you receive a message (spam) from someone, or want to find the true owner of a Web site, you begin with only the shared IP address. This address will point you to the company that hosts the original user. You can find the hosting company by entering the IP address at one of the registry sites, such as www.arin.net. But to find the specific person, the hosting company (or university) will have to provide you with detailed records of who was using the computer at the specific time. Most of these organizations will reveal the information only when presented with a court order (if they kept historical records). This process makes it more difficult and expensive to track down fraud and illegal activities on the Internet.

Domain Names

Numbers are difficult for most people to remember. So the Internet utilizes a system where a **domain name system (DNS)** server converts names to numbers. Anyone can apply for a name and pay a nominal fee (perhaps $20 per year) to use that name. Of course, names must be unique, so sometimes disagreements arise over popular names. Names are followed by a suffix such as .com, .edu, or .gov. Several newer suffixes were added in 2002 and 2003, but the .com and .net suffixes are still the most coveted. One interesting feature of the names is that each country is given a specific suffix. Some of the countries sell names using their unique suffix. For example, the small nation of Tuvalu allows companies to use its suffix (.tv) for a fee.

As a business, you will need to register your domain name to make it accessible to other users. Several companies act as registrars and you pay them to officially link your name to your IP address. In terms of data, the connection is ultimately performed with the DNS system, and you can either run your own DNS computer or pay another company to handle the updates. Figure 3.29 shows that DNS registration is a critical element to electronic commerce. Registration provides a tie between the Internet world and the real world. A second tie is provided by the connection of the firm to its ISP. In a legal situation, the ISP can be forced to reveal the true identity and address of its client. A third anchor is created when a company installs a digital security certificate. The certificate authority verifies the real-world identity of the client and binds it to the certificate.

You can use the Whois facilities of the domain registrars (e.g., NetworkSolutions, or Internic.org) to look up the registration data. You can use the Internet registries to identify ISPs based on the IP address. These registries are organized by geographical location and include ARIN (North America), RIPE_NCC (Europe, the Middle East and Central Asia), APNIC (Asia/Pacific), LACNIC (Latin America), and AfriNIC (Africa). However, some ethically-challenged people lie on their DNS registrations. A few even more ethically-challenged people operate ISP services specifically to support spammers and hackers. As a consumer, the answer is relatively easy: never, ever send money to a company that lies on its DNS registration!

If you want to run your own Web site, you will want to create and register your own domain name. The exact IP address will be given to you by your hosting ISP, but you have to register for the domain name that will be linked to the address. This registration information is kept in global **whois** databases. For example, you can use the networksolutions.com database to enter a Web site name and retrieve the registered owner of the site. When you register a site name, you are supposed to provide accurate information on your name, address, and phone number. However, at this point in time, the registrars have been weak at verifying the data. The resulting misleading information makes it difficult to track down spammers and other owners of fraudulent sites. In a sense, the Internet today is like the business world in the 1800s—any fly-by-night scammer can set up a business Web site. In the business world, this situation was partly solved by requiring businesses to obtain licenses and register with the government. If you have any doubts about the validity of a company, you should check to ensure that the business is legally registered with the state government. Most states have searchable online databases and provide free access through the office of the secretary of state.

Domain names can consist of several parts separated by dots. The names are read from right to left. The text on the far right is the top-level domain (TLD). The most familiar TLDs are the six that were created first: com, net, org, edu, gov, and mil. Several others have been added, such as info and biz, and new ones are proposed and debated each year. There are also hundreds of country codes (such as us, ca, uk, and tv). Around 2010, the Internet committees introduced the concept of generic TLDs (gTLD). In this case, companies or individuals will be able to purchase their own unique TLD (such as .ibm or .houses). The purchaser of a gTLD will act as its own registrar and be able to assign or sell domain names within that TLD. However, the initial cost (evaluation fee) for a gTLD is $185,000 and costs increase from that point; including the ability to run your own registry.

The second name is the name you must pay for and register with a DNS registrar. It usually is the name of a company or service, but could be almost anything.

Common examples include microsoft.com, google.com, pacific.edu, and sec.gov. Anything to the left of the registered domain can be created within your organization's network. Many times it is used to represent a department or specific server within the organization. However, there are no fixed rules so the names could represent almost anything. For example, you might create marketing.mycompany.com for the marketing department server. Why do you care? If you need to setup networks, you have to learn more of these details, and you have to design a naming convention that is easy to use. But, even as a typical user you should be familiar with the basic structure so you can recognize bad or dangerous domains. For example, accounts.citibank.com.xi92lai.293aafa.com is most definitely *not* an addressed owned by Citicorp. When you see that address in an e-mail message, you immediately know it is a fake—most likely created to steal your bank password.

For years, the Internet committees have realized that the domain name system is based on the English language and that many companies would like to create domain names in local languages. However, a name system based on multiple languages presents several technical challenges—notably, ensuring that names in different languages or alphabets are never reduced to an existing name in a different language. Another problem is that the DNS database was designed to hold only Latin-based characters. Most of these issues have been resolved and by 2011, several TLDs became available in non-English languages including Arabic and Chinese.

Internet Committees

The Internet works because of the adoption of standards. Everyone connecting a device to the Internet agrees to follow the standards. But, these standards need to evolve to handle new technologies. The standards are maintained and discussed by several Internet committees. The **Internet Corporation for Assigned Names and Numbers (ICANN),** the **Internet Engineering Task Force (IETF),** and the **Internet Assigned Numbers Authority (IANA)** are publicly run organizations in charge of establishing many of these standards. These organizations are heavily dependent on volunteers and rely on public comments to design new standards. The IETF is the most technical group and it deals with most of the routing and HTML standards. IANA controls the allocation of IP address segments, TLDs, and other assigned numbers. It is largely concerned with technical issues.

In some ways, ICANN is a more interesting group. It was not founded until 1998. It coordinates the Internet naming system. In actuality, it is the political committee where everyone gets to argue over various directions for the Internet. For example, it is the focus of discussions for whether new TLDs should be introduced, or when internationalized domain names should be allowed. Originally, these tasks were handled by U.S. organizations. ICANN is a not-for-profit corporation that is not directly controlled by the government, but it is founded in California. At various times, several nations have suggested that ICANN should be run as an international body—perhaps even within the United Nations. U.S. politicians have resisted these attempts to change control of ICANN.

Internet 2

Originally, the U.S. government funded much of the Internet design and development. By 1995, the U.S. government had discontinued almost all funding, and the Internet was largely financed and controlled by private organizations. From 1994, the commercial use of the Internet increased exponentially. In 1996, 34 university

Reality Bytes: Faster Speeds but Data Caps

In April 2011, AT&T announced that it would limit broadband customers to no more than 250 gigabytes of Internet data transfer per month. DSL users would be limited to 150 GB. The 250 GB value matches that imposed by Comcast. AT&T claimed that only 2 percent of its users would be affected by the caps, but that people in that group use up 20 percent of the network bandwidth. Data transfers above the caps will be priced at $10 for each 50 GB. Mark Siegel, spokesman for AT&T noted that the company's customers averaged 18 GB per month. He also claimed that the reason for the change was because customers said "that the people who use the most should pay more." The 250 GB cap could be reached by watching 109 hours of high-definition video from Netflix—or about 3.6 hours every day for a month. The comparison to video is important because customers are moving to online video and dropping TV services from AT&T and Comcast. Vince Vittore, a broadband analyst with the Yankee Group, noted that the data cap "isn't absolutely necessary. It's mostly a move to prevent customers from cutting off video services." Note that Cisco forecasted that video on-demand usage will double every 2.5 years. Verizon Wireless followed with data caps and substantially higher prices for heavy users in July 2011 (Web site).

Adapted from David Goldman, "AT&T Starts Capping Broadband," *CNN Online*, May 3, 2011.

participants decided that they needed faster connections (the number of participants expanded to 100 in 1999, 205 in 2003, and 381 in 2007 with 58 international participants). In early 2011, the list of paying participants included 260 organizations and 147 sponsored participants according to the lists on www.internet2.edu. With the support of the government and industry, they began creating Internet 2 (http://www.internet2.edu).

The two most important proposed features of Internet 2 are high-speed connections and quality-of-service provisions. The overall objective is to provide a transmission network that can support full-speed video and other high-bandwidth applications. To understand the change, consider that most existing "high-speed" Internet connections are in the range of 1 mbps to 50 mbps. The Internet 2 calls for gigabit connection points and a minimum connection of 155 mbps. The cost of connection depends on the connection speed, where a 1 gbps connection costs $250,000 a year.

A related, but more fundamental, change is the ability to specify a desired level-of-service quality. Currently, if traffic increases on the Internet, all communications slow down. This situation is annoying but not troublesome for simple tasks like sending e-mail or browsing a Web site. On the other hand, full video transfer requires a constant minimum level of transmission capacity. So participants need a mechanism to tell all components that a specific set of messages should take priority to receive a certain level of service. Some people have suggested that the system should enable participants to pay a fee to gain their desired levels of service, for each type of message. For example, basic e-mail messages would be free if there is no rush in delivering them. But to reserve a time slot for videoconferencing, participants would pay an additional fee. Then all of the Internet 2 components would give the video packets a higher priority. So far, there has been

Figure 3.30

Mobile commerce. Wireless connections offer new capabilities, such as e-mail and Internet browsers on cell phones.

no agreement on whether additional fees should be charged, or on how the quality-of-service issues can be resolved. Although the system is being designed for academic and government users, the industry participants (e.g., Cisco) ultimately intend to transfer any useful technologies to the commercial Internet. Businesses could find many uses for high-speed connections and service-quality guarantees. For starters, better video transfer may finally open the way for desktop videoconferencing to replace travel to meetings.

Wireless Networks and Mobile Commerce

Beginning with cell phones in the 1990s people and businesses have become fascinated with wireless communication. Wireless Internet and mobile commerce have the potential to revolutionize the Internet, business, and society. Technologically, wireless is different from the traditional Internet in only two ways: (1) the transmission medium is microwave radio, and (2) the client devices are smaller with smaller screens and less computing power. Yet wireless connections open thousands of new possibilities. The client devices can consist of anything from enhanced cell phones, such as the device shown in Figure 3.30, to laptops and digital tablets. Many of these devices are more powerful than some older computers. Most cell phones and tablets have built-in cameras, Web browsers, and their own programming or application capabilities. Touch screens have made it possible to enter basic text and notes on these portable devices.

To date, the wireless communication presents the greatest challenges. As the portable devices become more sophisticated, people want to use them for everything from simple text to voice to video. And video includes video calls as well as downloaded high-definition movies. The catch is that 3G cellular networks were designed to handle perhaps 2 mbps of data transmission. Even the early 4G sys-

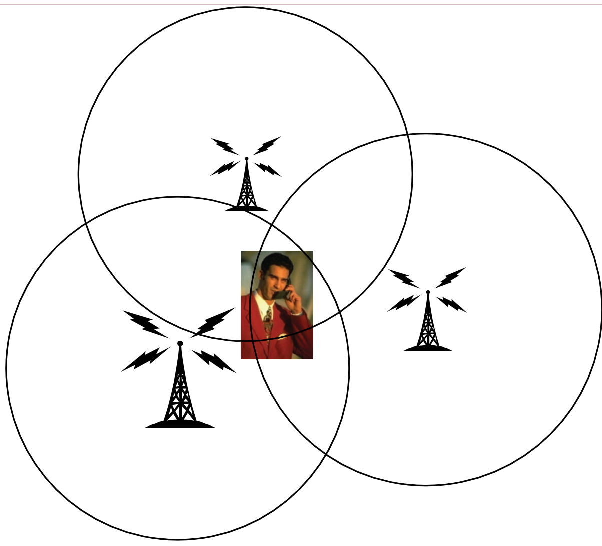


Figure 3.31

Location knowledge in m-commerce. Businesses could contact potential customers on learning their location through the wireless system.

tems provide download speeds of *only* 3 – 10 mbps. Upload speeds are substantially lower, often less than 1 mbps. Transmitting video on these wireless connections can be slow for individual users. Worse, the cell-phone space is shared by everyone in the area. Throw a few thousand people into the same location all trying to send and receive large images or video and the network slows to a crawl for everyone—as AT&T learned when it was the first to sell the Apple iPhone. Despite the increased money pumped into expanding the network, the growth of cell phones and data applications has expanded even faster. At some point, the cell-phone companies might be able to install enough capacity to handle the increasing traffic, but it is likely that data caps and usage charges will remain for heavy users.

Some of the more interesting possibilities of m-commerce come from the ability to use the phone to find and pay for virtually anything you might need. Rather than rely on credit cards or cash, your cell phone could record all of your transactions and give you complete instantaneous access to your data. But an incredibly reliable and secure system must exist before consumers will trust it. In 2011, several phone vendors began rolling out **near-field communication (NFC)** payment systems. NFC is a very-short range wireless communication method where either the cell phone itself or a tag placed within the cell phone can carry basic payment data. When waved next to a payment terminal, the ID is used to transfer money from your account to a vendor. Some credit cards—particularly those used in Europe use similar technology. The actual source of the funds (your bank account, credit card, cell phone bill, or PayPal) depends on the system being used. Several companies have created competing versions and it is not clear which one might win the largest market share.

Another interesting possibility for m-commerce comes from the ability to use location to identify potential customers. Figure 3.31 shows that it is relatively easy to identify a person's location based on the way the cellular system works using signal strength and triangulation. Most cell phones also have built-in GPS receivers and can locate your position down to a few feet. Currently, people can turn off most of the location broadcast data on their cell phones, but it is available for 911 emergency calls.

Think about the business opportunities that this system could provide, even from the perspective of a consumer. As you walk into a mall, you could enter your shopping list into a browser on your phone, which would contact all of the local stores for prices and availability, and then provide a local map and directions to each item. You could enter notes and make your selection through the browser, then press a couple of keys and purchase the items. Most cell phones and search engines provide a method to find companies based on your current location—such as the closest gas stations or restaurants that carry specific types of food. Similarly, some companies use a system that automatically tracks your location and notifies your friends (www.loopt.com). A few companies such as www.foursquare.com have built a system to encourage people to *check-in* to report their specific location in commercial stores.

Businesses have even more opportunities to collect data on customers, such as sending advertising to your phone and tracking the number of browsers versus buyers. But marketing systems have greater knowledge of exactly what products and features each customer wants. For instance, the systems could offer a mini-survey to each customer who chooses to buy a competitor's product to find ways to improve products. Of course, the privacy aspects are interesting. They are examined in Chapter 14.

Cloud Computing

Are personal computers necessary anymore? As network speeds increase, new computing methods are being created and rolled out to businesses and individuals. The generic term cloud computing is often used to describe applications where the server, and most of the software, are run on computers stored on Internet servers—usually leased from a third party. Figure 3.32 shows the basic concept. The main data and applications are running on servers located on the Internet. The results, whether data, images, or even video, are transmitted and displayed on client computers, laptops, or even smart phones and tablets. The key is that the main applications and data are centralized. Ideally, the user can access the data and applications using any device from almost any location. For these applications, the user needs only a simple client display device, often only running a Web browser. The data and applications remain on the servers.

Scalability and reliability are important aspects to cloud computing. The applications and data are run on distributed servers connected by high-speed networks. If one server fails, the load is automatically picked up by the other servers. Similarly, new servers can be added at any time to extend the performance of the collection. Data is stored on storage area networks—also connected with high-speed networks. Most service providers also have multiple server clusters running in different physical locations around the world. Data is replicated across the systems so it is closer to any user on the Internet. Each local cluster has its own high-capacity Internet connections. Most sites have dual connections from different providers. If one network provider goes down or has a line cut, the system automatically routes data through the backup connection.

Cloud service providers also use virtual machines to lease space on their hardware to multiple customers. Multiple VMs can run on one physical server. Between the hardware, networks, and personnel, the cloud providers make money through economies of scale. Consider the network costs alone. A T1 line providing 1.544 mbps might cost $400 a month to a single company. But, a giant provider can get an OC3 line for perhaps $20,000 a month that provides 155 mbps; or about half the cost per megabit per second. Plus, the higher-capacity line can be allocated across even more customers because most of them will have minimal traffic. In a large data center, the monthly network and power costs constitute a large portion of the expenses. A handful of employees with the appropriate software can monitor hundreds or thousands of servers, so personnel costs are relatively low. Selling capacity to multiple businesses helps cover the monthly costs. The more services they can offer, the more money they can attract.

But, it is difficult to answer the question of whether everything can be shifted to the cloud. Even if you completely trust the servers and the network, is there some data that you might wish to keep on your own computers? Or, is it always going to be easier to pay someone else to handle the software applications and data? These are the main questions that need to be answered.

Global Telecommunications

What problems are you likely to encounter if you need to connect to a supplier in a different country? Business firms are becoming more dependent on international markets. This internationalization increases the demands on the telecommunications system. The international transmission of data is becoming part of the daily business routine. A manufacturing company may have factories in several different countries, with the headquarters located in yet another country. Supplies have to be sent to factories. Finished and intermediate products have to be tracked. Customer demands have to be followed in each country. Quality control and warranty repair information have to be followed from the supplier through the factory and out to the customers. Financial investments have to be tracked on stock markets in many countries. Different accounting and payroll rules have to be provided for each country. Basic accounting and financial data have to be available to management at any time of day, in any part of the organization.

Creating networks across international boundaries creates many problems. Some of the complications are technical, some are political or legal, and others are cultural.

Technical Problems

The biggest technical complication is that each country may have its own telecommunications standards. Today, most people rely on cell phones—particularly in smaller, developing countries. Just as in the U.S., several different standards exist for cell phones. Consequently, a cell phone from one country might or might not work in a different area. Many of the European nations use a version of the GSM standard, so phones on those systems will generally work in multiple areas. However, some American travelers have learned the hard way that between roaming and international charges, using a phone in a different nation can be extremely expensive. Many European travelers purchase new SIM cards (subscriber identity module) to work in each country. A new SIM card essentially enables you to make local phone calls without roaming charges, but international calls can still be expensive. To handle those, frequent travelers can use VoIP systems such as Skype and find a WiFi connection to make low-cost international calls over the Internet.

One possible way to avoid the public telecommunications hassles is to use satellite phones. Some of these phones (notably Iridium) will work almost anywhere on the planet. Unfortunately, they do not work well inside large buildings because the signal gets blocked. Still, they can provide international reach even in remote areas and support small data transfers as well as voice. The traveler needs to purchase a special phone and sign up for a package of minutes. The per-minute cost (in 2010) averages about $0.90 – 1.30, which might seem high to people used to unlimited calls. However, even in the U.S., some cell phone plans charge $0.45 a minute; and international roaming charges in Europe can often exceed $1 a minute and some people have been charged over $3 a minute.

Fortunately, the Internet has made it easier to share data, images, and video regardless of location. So, although the U.S., Europe, and Asia use different television standards, the computers all handle the standard types of images and video used on the Internet. You might have to ensure that the recipient has an up-to-date computer to handle some newer types of video, but as time goes by, most computers should be acceptable. However, keep in mind that it might not be possible to plug your cell phone or laptop into a monitor in a different nation if you want a larger display. Still, you can usually transfer the data and use a local system.

Legal and Political Complications

Some important problems can be created when a firm wants to transmit information across national boundaries. These transfers are called **transborder data flows (TBDFs)**. The problem arises because the information has value to the sender. Some of the biggest complications today are political. Some nations exert strong control over the Internet. For example, in China the government physically owns and runs all of the Internet routers. That gives them complete control over traffic. The government commonly filters traffic for certain keywords and blocks sites that it deems to be against public policy. As another example, during the Egyptian turnover in January 2011, the existing president (Mubarak) appears to have ordered the shutdown all Internet routers in an attempt to prevent protestors from communicating. He also shut down all cell phone service for a couple of days. [Vijayan 2011] Ultimately, all he managed to do was demonstrate to all citizens that he had no respect for them and he was forced to step down.

Several other nations have expressed concerns over cell phones—particularly the Research-in-Motion Blackberry which promises strong encryption. In 2010, some Middle Eastern countries along with India threatened to ban Blackberry unless the company provided a way for government authorities to intercept civilian communications. They are not alone. The Obama administration also worked on a plan to obtain access to decrypted messages using wiretap authority [Rashid 2010]. The issues of tradeoffs between privacy and government monitoring are explored in more detail in Chapter 14. For now, it is important realize that technologies commonly used in one country might be banned in another country. It is important for travelers and businesspeople to keep up with the laws of the nations in which they operate.

Another important issue revolves around typical marketing data about customers. It is common for marketing departments to maintain huge databases. These databases contain customer names, addresses, phone numbers, estimated income levels, purchases, and other marketing information. Problems have arisen because the western European nations have much stricter laws concerning privacy than the United States. In most European nations, it is illegal to sell or trade customer data to other companies. It must also be stored in protected files that cannot be seen by unauthorized employees or outsiders. In most cases, it is the responsibility of the company to prove it is meeting the requirements of the law. In many cases, this requirement means that customer data must be maintained on computers within the original nation. Also, this data cannot then be transmitted to computers in other countries. As a result, the multinational company may be forced to maintain computer facilities in each of the nations in which it does business. It also needs to impose security conditions that prevent the raw data from being transmitted from these computers.

There is one more important political issue involving international computer centers. Many nations, especially the developing nations, change governments quite often, as well as abruptly. There are many nations where terrorist activities are prevalent. Oftentimes, large multinational companies present tempting targets. Because computer centers tend to be expensive, special security precautions need to be established in these countries. Probably the most important step is to keep the computer center away from public access. Several U.S. security specialists publish risk factors and suggested precautions for each country. They also provide security analysis and protection—for a fee.

A host of other political complications affect any multinational operation. For example, each nation has different employment laws, accounting rules, investment constraints, and local partnership requirements. Most of these can be surmounted, but they usually require the services of a local attorney.

Cultural Issues

All of the typical cultural issues can play a role in running multinational computer networks. The work habits of employees can vary in different nations. It may be difficult to obtain qualified service personnel at some times of day or night. These issues can be critical for computer networks that need to remain in operation 24 hours a day. In many nations, it is still considered inappropriate to have female managers when there are male subordinates. Collecting information may be exceedingly difficult or even culturally forbidden. In some countries, you will lose a customer if you try to obtain marketing data such as age and income.

In some nations, the connections between suppliers and customers are established by culture. For instance, in Japan, distribution of products is handled by only a few large firms. These companies have established relationships with the suppliers and retail outlets. In any country, it can be difficult for an outside firm to create a relationship between suppliers and customers. Trying to build computer networks with the various companies could cause severe repercussions. The established firms may think you are trying to steal their knowledge or information.

Summary

One of the most important concepts in MIS is the necessity of sharing data. But networks have gone beyond simple data to becoming a major part of the use of computers and accessing information. Many applications and business tools rely on almost-constant connection to the Internet and other devices. As a manager, you need to work in this world where you can search and connect to data and people from many different parts of a company. It also means that you need to be accessible and make your knowledge and skills available to other workers on the team.

Communication and networks require standards, and they need to evolve over time. One of the greatest shifts taking place now is the move to high-speed wireless communication. Physically, computer components have shrunk far enough so that even relatively small cell phones carry huge amounts of computer power. As people carry these devices everywhere, they want access to everything from anywhere in the world. The current challenge lies in building and paying for a wireless infrastructure that can handle the increased load created by everyone demanding high-speed access at the same time. The second challenge for business lies in determining how to use these connections and applications to improve management and increase profits.

Building networks requires specialized workers and skills, but managers need to keep up with some of the changing technology to make beneficial choices. As technologies and prices change, managers often need to determine when to implement new technologies and when to wait. Making these decisions often requires understanding the underlying technologies and trends. Managers also need to be aware of the fundamental economics, particularly the economies of scale involved in networks. Decisions need to be made about leasing space and network capacity versus building and managing your own connections. And these decisions need to be reviewed as prices change and new firms enter the industry.

Globally, telecommunications reach around the world. But capabilities and technologies vary by nation. And the U.S. is not always at the top of the world. Still, if a company wants to connect to customers and suppliers in other nations, managers need to be aware of potential conflicts. Technology differences remain, pricing issues can be huge barriers, and political restrictions can cause complications with many types of communications and applications. Most of the problems can be avoided or bypassed but it helps if you search for them and make plans ahead of time.

A Manager's View

The goal of telecommunications is to remove location as a factor in management and decisions. Technologies exist to enable you to connect to almost anyone, anywhere in the world to share data, voice, and video. However, bandwidth or the speed of transferring data varies considerably, and transferring large amounts of data can be expensive. Still, as speed and availability increase, new businesses and new ways of operating businesses are being developed. Opportunities exist to create expand and profit as the world becomes more interconnected.

Key Words

- bandwidth hogs
- blog
- Bluetooth
- Broadcasts
- coaxial cable
- co-locate (colo)
- direct sequence spread spectrum (DSSS)
- domain name system (DNS)
- dynamic host control protocol (DHCP)
- e-discovery
- e-mail
- extranets
- file transfer protocol (FTP)
- frequency division multiplexing (FDM)
- grid computing
- Groupware
- hypertext markup language (HTML)
- instant messaging (IM)
- Internet service provider (ISP)
- Internet Assigned Numbers Authority (IANA)
- Internet Corporation for Assigned Names and Numbers (ICANN)
- Internet Engineering Task Force (IETF)
- Intranet
- IPv6
- last mile
- latency
- local area network (LAN)
- media access control (MAC)
- near-field communication (NFC)
- network address translation (NAT)
- network interface card (NIC)
- packets
- peer-to-peer networks.
- podcasts
- point of sale (POS)
- portable document format (pdf)
- really simple syndication (RSS)
- scalability
- server farm
- social networking
- standards
- storage area network (SAN)
- time division multiplexing (TDM)
- transborder data flows (TBDFs)
- transmission medium
- twisted-pair
- ultra-wideband (UWB)
- voice over IP (VoIP)
- whois
- WiFi
- Wikis
- WiMax

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SEC Edgar	www.sec.gov
Motley Fool	www.fool.com
Wall Street Journal	wsj.com
Yahoo Finance	finance.yahoo.com
Discount Online Trading	
TDAmeritrade	www.tdameritrade.com
E*Trade	www.etrade.com
Fidelity	www.fidelity.com
Charles Schwab	www.schwab.com
ScotTrade	www.scottrade.com

Review Questions

1. Does it matter where data is stored anymore? Are networks reliable and available enough to assume data and processing can be handled anywhere?
2. Why do businesses use networks to share hardware?
3. How is cloud computing like renting software?
4. List the main components of a network.
5. List the types of transmission media that are available. How do they compare in transmission rates and cost?
6. What are the main advantages and drawbacks to wireless networks?
7. How do networks handle multiple users at the same time?
8. Why are standards so important in networks?
9. What organization is responsible for creating (or not) new top-level domains on the Internet? Should this group be adopted and controlled by the United Nations?
10. What type of network service do you need to run a Web server? Newer (LTE) phone speeds are reported to be over 10 mbps; would it be possible to use those to run a Web server?
11. Why are some cell phone networks so slow?
12. Why is the domain name system so important and what is the role of domain registrars?
13. What is the Internet2 and how will it affect businesses?
14. What problems arise with global telecommunications?
15. Describe the process by which a computer is assigned an IP address.
16. Some people and a few members of the Internet committees have suggested a substantial increase in the number of top-level Internet domains. Why is this a bad idea for businesses?

Exercises

1. Some cell phones have the ability to function as a Wi-Fi to connect other devices to the Internet using the cell phone network. Most tablets have an optional cell phone connection. Choose a tablet and a cell phone from the same service. Compare the costs of paying to connect the tablet directly to the cell network versus paying for the Wi-Fi connector and connecting through a cell phone.
2. Find at least one method to connect a printer to your home (or school) network so that it can be shared by all users on the network. How would you limit access to specific people, or track the number of pages printed by each person?

3. Using the Internet, find at least two software packages that will back up data across a LAN. Briefly explain how the software functions and what components need to be installed. Estimate the price of the software for a network of four servers and 100 clients.
4. Research to find the service that generates the most amount of traffic on the Internet today.
5. Design your "perfect" wireless communication device. Possibly draw it, but identify the features that you would want. Rank the features by importance (descending order) and write a brief reason for your top three selections.
6. Assume you want to start an e-business. What steps do you have to take to obtain and establish a domain name for the business? How much will it cost?
7. Choose two existing Web site names. To make it more interesting, one of them should be from a spam site. Use the Internet resources to obtain as much information about the company and owner as you can. Note, you should also check the office of the appropriate secretary of state. [Answer depends on companies, but at least provide the output from www.arin.net (or www.apnic.net) and www.networksolutions.com (or www.internic.org)]
8. Check vendor advertising and identify the costs and speed of the following services:

   a. DSL from the phone company.

   b. Cable modem.

   c. Cell phone Internet access.

   d. Dial-up Internet access.

   e. ClearWire.

   f. Wireless access at a local hot spot.

9. Identify the cost of running a server on Amazon's cloud system using an entry-level Web server running Microsoft Windows Server. Assume the site you create will contain about 5 GB of data and handle about 500 gigabytes of data transfer (outbound) in a month.
10. Estimate how long it would take to transmit the following information.

    a. A 5 megabyte image file over a 3G cell phone (70 kbps).

    b. An e-mail message with a 120 megabyte video clip attachment over a 5 mbps cable-modem connection.

    c. A 1 gigabyte data folder over a 100 mbps local area network connection.

    d. A 1 gigabyte data folder onto an SSD drive that can write 270 MB/second.

    e. If possible, test the above examples with real data.

    f. Why would the actual transfer times be slower than the estimated numbers?

11. Identify at least three major features provided by HTML 5.

Technology Toolbox

12. Create three Web pages that are linked. Include at least one image.
13. Create a style sheet for at least two Web pages and demonstrate how the look of the site can be changed by altering the style sheet.
14. Create a simple Web page using Microsoft Word and save it. Create a similar page using either straight HTML or an HTML editor such as FrontPage. Compare the two files and comment on the differences.
15. Find three Web hosting companies and identify the file transfer methods supported by each company. Does the company charge extra for some methods?
16. Briefly describe the purpose of server programming for Web pages and how it differs from client-side scripting.

Technology Toolbox

17. How are files uploaded to YouTube?
18. How are files uploaded to the Amazon S3 service?
19. Find a commercial Web hosting company and list the methods that it supports to upload files.

Teamwork

20. For each member in the team identify (a) how many e-mail messages they send a day, (b) the number of text messages sent per day, (c) the number of phone calls made per day. Combine the results from all team members and comment on any patterns. Why would people send more cell phone text messages than e-mails?
21. As a group answer the following two questions. Is it possible to live with only one wireless device? Can it be standardized within the group?
22. You have an American cell phone and will be traveling to Europe for two months. You want to have cell phone service so that your friends and coworkers can reach you in an emergency. You also want to be able to call people and places in Europe while you are there. Each team member should find a different way to provide this service. Share your results, compare the costs and benefits and choose a plan.
23. Each person should find a software package that is used to create Web pages. Summarize the basic features, ease of use, target market, and its price. Combine the data and recommend a package that could be used by a marketing department to design basic Web pages.
24. If a network is available with Microsoft Outlook (or similar package) on each client, add each team member to the Contacts list. Each person should enter a few items in a personal calendar to block out some times for one week. Then share the calendars and use the system to schedule a meeting.

25. Interview managers, friends, or family members who have jobs and identify where their primary files are stored. Are they stored on local computers, on a department file server, or at a more distant location? Who is responsible for backup? What is the process for recovering lost files? Combine each result into a document. Create a table and a chart to summarize the results. Write a short paragraph suggesting improvements.

26. If you have access to computers running Windows 7 or above, have each team member determine the IPv6 address of a machine and compare the results. Hint: You can always use the command line program ipconfig.

Rolling Thunder Database

27. Design a network for the Rolling Thunder Bicycle Company. Identify who will need access to the network; how many workstations you will need (and where to place them); the data, input forms, and reports users will need. Using the existing data, estimate the storage requirements and transmission needs. Specify how changes and growth will affect the type of network needed.

28. Describe how the Internet could be used to increase sales at Rolling Thunder Bicycles.

29. Rolling Thunder Bicycles wants to expand international sales. What changes would need to be made to the application? What problems would you expect to encounter, and how would you overcome these potential problems?

30. The manager of Rolling Thunder Bicycles wants to access the database from home. Describe some options of how this could be done. What potential problems might arise?

31. If you have access to laptops and a wireless network, test the database running over a wireless connection. If five or six people want to use the system with wireless devices, what problems might arise? Do some research: Is there a system that can help?

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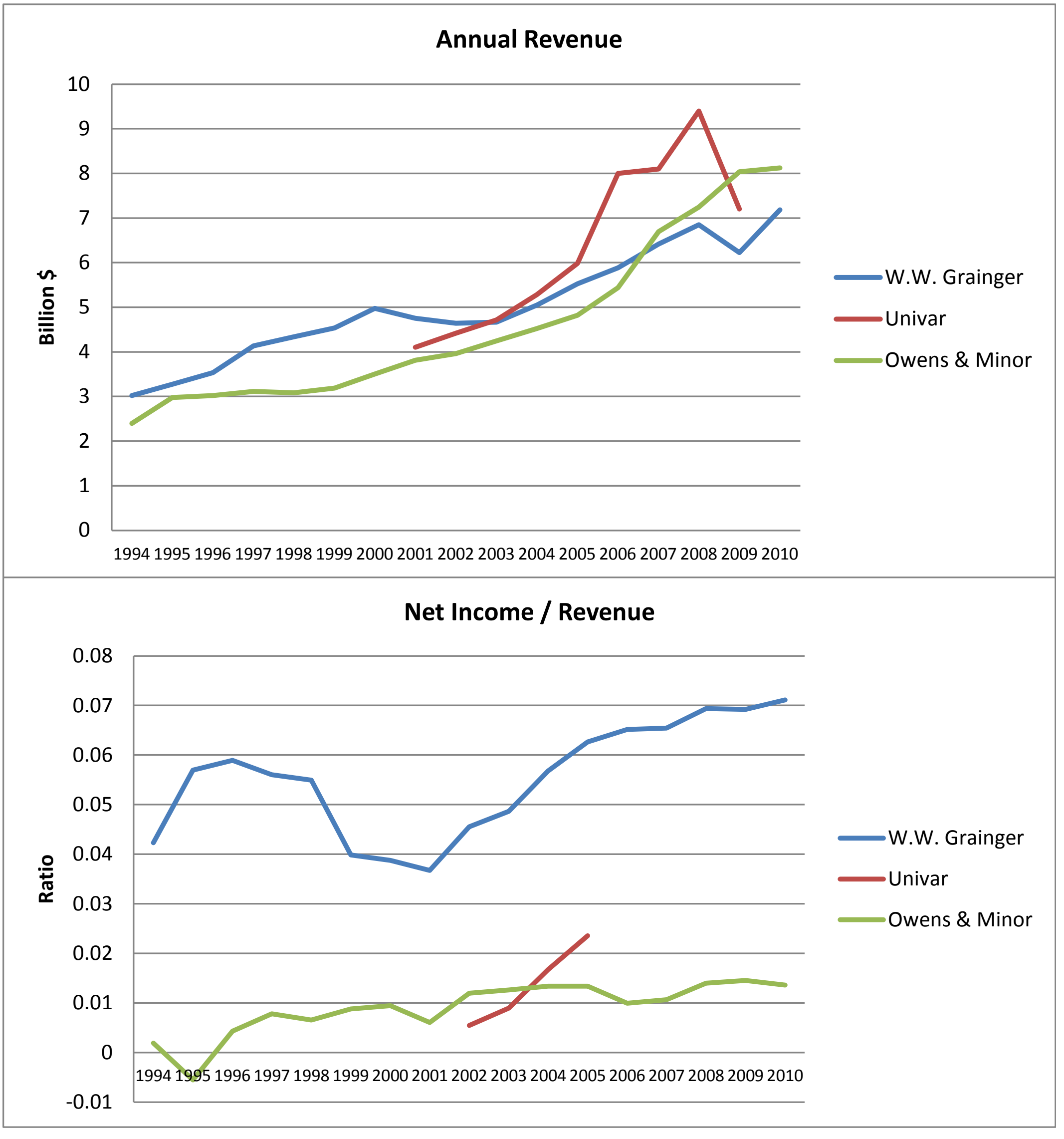
Cases: Wholesale Suppliers

The Industry



Wholesale suppliers are the original business-to-business providers. In many ways, they are like any other manufacturer or retailer. The difference is that their primary customers are other businesses. Selling to other businesses often means that the company supplies bulk items, but some wholesalers specialize in small, hard-to-find items. Some wholesalers provide commodities, such as raw chemicals. That raises one of the big challenges: differentiating your company from the competitors. What makes one company's products different from the others? In most cases, it is not the product that matters, but the customer service. Sometimes location is a key aspect to providing service, so small firms can survive by carving a local niche. But the big firms often have an advantage in economies of scale, driving costs down by serving large geographical regions through distribution centers. Some of the large commodity providers are global in scope. But size raises a new set of problems: managing a global company that has grown through multiple mergers. Communicating within the company is difficult enough. Communicating a consistent message to customers can be exceedingly hard.

Payments are another challenging issue for wholesalers. Manufacturers often squeeze vendors by stretching payments to the future. Small firms often pay the price in these cases, because it puts pressure on their cash flow when they do not receive payment for 90 days. Technology cannot always solve this problem because it is a power balance between vendor and customer. However, it can at least track the payment history and make the entire process transparent to both sides.

B2B Ecommerce

Communication is the entire purpose of electronic networks. Internal networks are useful for collaboration and coordinating employees. For customers, the big leap in the last decades has been e-commerce—particularly business-to-business (B2B) sites. B2B sites can be set up by one company, focused on providing a single interface for its customers. Alternatively, it might be a site shared across the industry by multiple suppliers and many customers. Several auction-based Web sites were created around 2000 to increase competition and make it easier for customers to find and purchase various items. Many of these sites later failed; however, a few remain in some key industries. Both sellers and purchasers have to decide what type of B2B site works best for each type of product.

A shared site can be run by a neutral party, with costs shared by everyone. Hence, it can be easier for smaller firms to participate. But auction-based sites tend to drive down the prices of commodities, so sellers might not want to use them. From the perspective of the buyers, they might prefer a tighter relationship with one or two suppliers. If you compete only on the basis of price, suppliers might not be responsive when crises arise. Ultimately, one of the big questions for buyers is how much of the logistics they want to handle themselves, versus how much they want to outsource to the vendors.

Logistics

Distribution is a key factor in the wholesale industry. Suppliers need to get products to the customers. Sometimes the products are bulky. In the case of chemicals, they might be volatile and difficult to transport. But that is the point of customer service by the supplier. On the other hand, logistics involves more than just transportation. It includes tracking orders and payments, timing the deliveries, finding rare products, tracking shipments, and recording everything in a format that can be shared. Elemica is a multi-vendor Web site for the chemical industry. Its Web site notes that an average international shipment requires 6 participants, 20 documents, and between 4 and 12 weeks of time. One of Elemica's selling points is a software tool to track the entire process and integrate the data between the supplier and purchaser enterprise resource planning (ERP) systems.

Wholesalers also have to make difficult decisions about inventory levels. Increasingly, through just-in-time ordering systems, manufacturers have pushed inventories back to the suppliers. Consequently, suppliers have to continually evaluate and forecast customer demands, compare them to world supply levels, and determine how much to stock of each item in every location. Linking to customer databases can be a useful step, because it enables suppliers to quickly spot trends and make more accurate forecasts (Babcock 2003).

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Case: Owens & Minor

Founded in 1882, Owens & Minor (ticker: OMI) is a leading distributor of medical and surgical supplies to hospitals in the United States. It is also a health care supply chain management company that can run the entire logistics side for hospitals. In 2006, the company distributed almost 120,000 products from over 1,000 suppliers. It had 41 distribution centers and a total of 3,200 employees distributing products to about 4,000 customers (annual report 2006). By 2010, the number of customers had increased to 4,400 supported by 52 distribution centers and 4,800 employees (annual report 2010).

The company purchases medical items in bulk from suppliers and stores them in its warehouses, which are close to customers. Most warehouses deliver within a 200-mile radius. Customers can order through a variety of systems, including a stockless, automated system where Owens & Minor employees deliver individual items as needed. Although the company purchases items from almost all of the medical manufacturers, about 16 percent of the net sales in 2003 consisted of products from Johnson & Johnson and 14 percent from subsidiaries of Tyco International, which includes the Kendall Company (annual report). Its major nationwide competitors are Cardinal Health (whose roots lie with American Hospital Supply Corporation), and McKesson. In 2006, sales revenue reached $5.5 billion with a net income of $49 million, which represent a 16 percent increase in revenue but a 25 percent decline in profit from 2005. But the move into new offices accounts for some of the increased costs (2006 Annual Report).

Delivering Supplies

Until 1998, O&M was simply delivering supplies to hospitals. In that year, the company was hit with the loss of substantial revenue when HCA Inc., the biggest health care provider in the United States, decided to take its business to another company—immediately reducing O&M's revenue by 11 percent. The company decided that the answer was to go beyond simply selling and delivering products. It needed to provide entire supply chain management tools to hospitals. The company estimates that hospitals spend an additional 40 percent of their supply costs just managing the logistics, tracking orders, and restocking. David Guzman, hired as CIO in 2000, notes that "there's only so much blood you can squeeze from a turnip in terms of the product price. But there's a lot you can do with the logistics costs" (Kontzer 2003). Consequently, O&M decided to extend itself deeper into the supply chain on both the hospital and manufacturer ends. CEO Bilmer Minor III notes that "our business has been built on supply-chain services and customer service. We realized our difference would be based on providing information" (Kolbasuk 2001).

Logistics Services

As a distributor, O&M understands the importance of networks for connecting to customers and suppliers. The company survives on price differentials—buying products at discounts from manufacturers and distributing them to hospitals. With fierce competition, it has to use technology to hold down costs to make a profit—about 1 percent on sales (Stahl 2004).

One challenge that O&M faces is that its customers (hospitals, nurses, and physicians) are several years behind in technology. Craig Smith, president of O&M, estimates they are as much as 20 years behind. Smith believes that radio frequency identification (RFID) chips can make a substantial difference by helping hospitals track everything they own from beds to drugs. "We're headstrong into RFID. It will have a significant impact on our business" (Stahl 2004).

Beyond the simple warehouse and transportation services, O&M has created several tools to help hospitals reduce their costs. The OMSolutions division is a professional services unit that handles consulting and outsourcing to help hospitals reduce costs. The team handles everything from stockroom and process redesign within a hospital to outsourced management of supplies (annual report). The CostTrack system is another tool to help customers analyze their costs. Using activity-based costing, the system shows customers exactly how much each step of the purchasing process is costing. It enables hospitals to then choose exactly which parts of the process they want to outsource to O&M. In 2003, 32 percent of O&M sales were generated through the CostTrack system (annual report).

One big problem that hospitals face is that they buy supplies from many sources. As much as 50 percent of the purchases are direct from manufacturers. Other items might be purchased from multiple suppliers and distributors. So O&M developed the Wisdom2 analytical tool. It collects all purchasing data from a hospital and makes it available as a single dataset. It tracks purchases from competitor suppliers as well as directly from the manufacturers. Judy Springfield, director of corporate standardization and contracting at Baylor Health Care System (a nine-hospital network), says that "we've just been dying for data" (Kontzer 2003). The Wisdom2 system provides the detailed data she wants, across all of the purchases, and even puts it into a spreadsheet. Wisdom and Wisdom2 are also useful to O&M directly.

Ultimately, Owens & Minor would like to simplify the ordering process even more—to the point of automated replenishment. If the system can forecast usage rates, O&M employees could deliver new items to the hospital and track the entire process, without needing a separate order from the hospital. Guzman thinks the process is feasible, "You'd be surprised how remarkably predictable demand is in the healthcare system. And I don't mean in general. I mean system by system. Massachusetts General is different from Stanford Hospital, but Stanford in its own right is predictable, as is Massachusetts General" (Kontzer 2003).

O&M also uses technology and networks to improve its operations. Remember that margins are extremely tight, and saving costs is critical. A new warehouse-management system in 2001 that uses wireless technology to guide workers increased productivity by 20 percent (Kolbasuk 2001). Notice that O&M manages to record over $4 billion of sales a year with only about 3,200 total employees.

New Systems

To provide new services, Owens & Minor needed new systems. But before building new systems, the company first needed to consolidate its information technology team. In 2002, the company canceled an outsourcing contract with IBM and expanded an arrangement it had with Perot Systems. The goal was to consolidate data centers to save costs, but also to begin creating new technology systems (Vijayan 2002). The company's main goal is to redesign the legacy systems so they use Web services to integrate all of the components. Ultimately, every information system the company has will need to connect to the OMDirect Web portal. Integrating the systems is still difficult and requires a new system architecture that uses XML to transfer the data. Guzman notes that "you can't go out and buy Web services. It's clear you have to be the one to build [them]" (Murphy and Bacheldor 2003), so the process is scheduled to take three years.

In 2006, Owens & Minor extended its outsourcing agreement with Perot Systems, committing to migrating their mainframe systems through 2014. Perot Systems also helped transfer and integrate data from the purchase of McKesson. The most important step was linking the O&M systems with those of the new customers (2006 Annual Report). The purchase of McKesson reduces the number of national providers to two: O&M and Cardinal Health. With the purchase of Access Diabetic Supply, LLC in 2005, O&M has become the third-largest mail-order supplier of diabetes supplies; but faced problems with not getting paid by many end-customers. The company prides itself on being an early adopter of computer technology—largely used to reduce costs and improve productivity. The company distributes 180,000 products from 1,200 suppliers, so tracking inventory and purchases are important. They also provide software management tools for operating rooms across the nation, including QSight, SurgiTrack, Wisdom, and PANDAC, an operating room inventory management program. O&M uses these tools to control and reduce inventory costs. Wisdom is a business intelligence tool that helps customers analyze their supply usage. Sales to the top 10 customers constituted 20 percent of revenue, so providing support and linkages are critical to the success of O&M.

In 2010, O&M needed to move its custom ERP system onto new Windows servers. The original system was a custom COBOL application running on mainframe hardware, consisting of about 10 million lines of code. The company decided that the complex business logic built into the code was too valuable to lose and too expensive to recreate. So it used Micro Focus COBOL and tweaked the code to run on Windows-based hardware (Thibodeau 2010). In addition to saving money by not buying and customizing a new ERP system, the company cut its hardware costs in half.

The company had been looking at the project for several years and struggled to find a way to transfer the system without "bringing the business to a grinding halt for six to nine months," as CEO Craig Smith put it (Nash 2010). Transferring to a new ERP system ultimately saved $100 million. The new system simplifies usability. When a customer calls in, sales representatives can see all of the relevant data on one screen instead of searching 11 or 12 screens to get an answer.

Security

With any network system, and particularly with Internet-based systems, security is a critical factor—particularly in the health care industry. At one level, security today is relatively straightforward: identify each resource and user, and then assign the appropriate permissions to users. Except that with thousands of users and hundreds of applications, it is expensive to manage the tasks. Owens & Minor has more than 12 administrators who are dedicated to managing, adding, and deleting employee and customer access rights (Hulme 2003). And, the company has to be extremely careful to monitor access rights to ensure they are correct and that they are updated as employees change jobs or leave the company. To simplify the process, O&M is consolidating the identity databases onto a single centralized Microsoft Active Directory repository. Active Directory (AD) runs on Microsoft servers and holds user credentials. It can be accessed by a variety of applications and services. Users essentially login to AD, and the system authenticates the user to other applications. O&M is also using IdentityMinder from Netegrity Inc. to transfer the user rights into the 20 or 30 applications accessed by each user. Paul Higday, chief architect for O&M, notes that "what this will allow us to do is set up a user based on what they're allowed to access with a single click instead of having to manually add each account" (Hulme 2003).

Questions

1. How does Owens & Minor use networks and information systems to reduce costs?
2. Given the innovations by American Hospital Supply in the 1980s, why are hospitals not even more integrated into the supply chain?
3. How are logistics services different from simply delivering supplies?
4. How will RFID affect the use and purchasing of hospital supplies? Will the technology be widely accepted?

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Case: W.W. Grainger

Founded in 1927 in Chicago, W.W. Grainger (ticker: GWW) is in an interesting industry. The company supplies products to other businesses for maintenance, repair, and operations (MRO). The products include janitorial supplies, light bulbs, and bolts. But the repair side can include any number of unique parts or tools used to repair equipment, from gaskets to pumps. The company estimates the U.S. market for MRO to be $100 billion a year, giving Grainger about a 5 percent share of the market—the largest of any competitor. About 90 percent of the market is filled by local and regional suppliers, and Grainger's strategy is to capture market share from these fragmented rivals. In 2003, the company had 575 sales outlets backed by 17 distribution centers and carried more than 500,000 different products (2003 Annual Report). In 2006, Grainger had sales of $5.9 billion with net earnings of $383 million. In 2004, Grainger began installing more outlet stores in major metropolitan areas—in a goal to make it more convenient for people to purchase products. The company expected to spend $50 to $80 million on the project, as well as $10 to $15 million on information technology. (2006 Annual Report). In 2010, Grainger had sales of $7.2 billion with 607 branches, including new outlets in Asia in Latin America. By 2011, Grainger carried 354,000 different products and James Ryan, the CEO, has a goal of reaching the "sweet spot" of 450,000 – 500,000 different products (2010 Annual Report).

As a distributor and supplier, Grainger makes money on the price differential by purchasing items in bulk and selling them at a markup to customers. But the markup is small. However, Grainger is expanding into the logistics market. The company estimates that about 40 percent of the total procurement cost comes from trying to locate and purchase MRO products. One of Grainger's competitive strengths is the number of products it carries and makes available almost immediately at any of its stores. Customers need to know that Grainger will carry the parts and supplies they need, regardless of the manufacturer. Parts that are not stocked in the local branches can usually be shipped for next-day delivery out of the distribution centers. To strengthen its local presence, Grainger is adding more showrooms and warehouse capacity across the United States. The goal is to have an outlet within 20 minutes of most businesses and institutions (annual report).

Of course, it does not make sense to carry products that rarely sell, so Grainger has to carefully choose the products that it holds in inventory. The company also works closely with manufacturers to reduce cycle times so that they can quickly refill warehouses or custom-order products if needed. Grainger manages the inventory problem by using multiple channels. Its 3,700-page CD-ROM catalog describes 82,000 products. Its Web site offers more than 200,000 products. When customers need more specialized repair parts, Grainger's Parts division can obtain more than 2.5 million parts from its suppliers. The FindMRO division is even more specialized and can track down over 5 million facilities maintenance products (annual report). George Rimnac, vice president and chief technologist at Grainger, observes that "many of the products we sell are products our customers didn't know they needed until today" (Pratt 2001).

The FindMRO division demonstrates a key element of Grainger's success: its knowledge base. Between its systems and workers, the company is extremely successful at finding parts, including chemicals to fuel Universal Studios' fog machines. This knowledge has a huge value to Grainger. A typical online order is worth $250 with small profit margins. Orders on FindMRO average $1,200 and 80 percent of the items are shipped directly from the manufacturer—giving Grainger an immediate profit (Sviokla 2001).

Grainger has been adversely affected by the transfer of manufacturing from the United States to other nations. The company has countered this shift somewhat by focusing on health care and government agencies—which cannot easily move offshore. At the same time, the company is expanding its purchases from lower-cost offshore suppliers—particularly for house brands ("Top Distributor" June 2003).

Logistics Services

Selling to businesses and government agencies is a key component to growth for Grainger. But Grainger knows that simply offering them products is not good enough. Grainger has developed sophisticated information tools to help customers analyze and replace their purchasing systems. The company's Integrated Supply division is a professional services group that will reengineer a customer's stockroom and provide a just-in-time inventory system.

Like other distributors, Grainger was hurt by the economic downturn of 2001 and 2002. Although sales revenue declined, the company used its supply chain software to boost its profit margins, resulting in an increase in net income (Konicki 2002). The company also expanded its investments in warehouses and information technology. Rimnac observes that "if you have financial resources, a recession is a good time to invest so when the rebound comes you can excel" (Konicki 2002). After another decline in sales in 2002, yet a continued improvement in profits, CEO Richard L. Keyser commented that "we remain committed to improving service to our customers as they continue to look for ways to reduce costs. Enhancements to our logistics network and local availability of the right products will provide higher levels of service. Our initiatives should accelerate sales growth as more customers experience this improved service" ("Lower Sales" August 2003).

To combat these changes, Grainger is expanding into additional services. In 2001, the company opened an on-site branch at Florida State University. It followed by opening a second on-site branch at Langley Air Force Base in 2002.

In 1996, Grainger took on a more in-depth role at the American Airlines facility at the Dallas/Fort Worth airport. The company essentially took over all janitorial and MRO services for the facility. With its success, two years later, the contract was extended to cover the nearby American Airlines headquarters building. In 2003, the company ran integrated supply programs for more than 40 customers. Large customers with over $2 million a year in MRO purchases from Grainger are eligible for the program. Grainger customizes the service for each company, but essentially, Grainger identifies the inventory needs and handles everything from ordering to stocking and might even include an on-site center distributing products to employees. At American Airlines, Grainger was able to substantially reduce the amount of MRO inventory sitting around. At the same time, facility worker complaints about not having the necessary tools available disappeared (Fraza 2003).

Grainger experimented with several Web sites and e-business approaches before reaching its current configuration. In 1999, the company had multiple Web divisions, including OrderZone (a marketplace), FindMRO (a search site for hard-to-find parts), and MROverstocks (an auction site). It also had relationships with logistics sites such as Ariba and Commerceone as well as several other e-marketplaces. Carol Rozewell, vice president research director at research firm Gartner Inc., noted that "Grainger customers were confused. They offered such a wide variety of products, customers needed guidance to navigate [the Web sites]" (Maddox 2002). Ultimately, Grainger killed off all of the sites except the company's main site (grainger.com) and the FindMRO site that is accessed only through the main site. But Grainger spent more than $180 million on Internet technologies and took a $23.2 million charge, followed by a $13.4 million write-off of digital properties (Maddox 2002). The main Web site was redesigned to make it easier and faster to use.

Internal Systems

Despite the growing importance of Web-based sales and in-house ties to customers, Grainger is also emphasizing increased sales through its local branches. Pushing products more efficiently through the local stores is the main reason for the $200 million redesign of Grainger's distribution system (Buss 2002).

One step Grainger took to improve efficiency was to install an SAP R/3 ERP system in 1999. Unfortunately, Grainger had several problems installing and configuring the system. For example, the ERP software miscounted the items on hand—partly because of problems in the transaction-processing subsystem. In the first year alone, the system cost Grainger $19 million in lost sales (Stedman 2000). Ultimately, Grainger got the system fixed and consolidated its financial data onto a single system. One of the problems Grainger had was trying to connect too many outside products to the SAP system. In 2003, the company began phasing out the old systems and using standard SAP components instead. Jarnail Lail, vice president of business systems, observed that the move enabled the company to reduce the number of outside consulting firms from 100 down to 10 (Colkin Cuneo 2003).

Despite the integrated enterprise resource planning system, Vice President of Finance Laura Brown wants more. In particular, she wants to be able to match sales figures with expense data in real time (Colkin and Whiting 2002). The principles of the Sarbanes-Oxley Act are scaring financial managers and executives who want to ensure that the numbers the systems are spitting out are true representations of the business finances.

In January 2006, Grainger implemented an Enterprise Resource Planning System from SAP. The goal was to integrate the information across the channels, products, and logistics network. CEO Richard L. Keyser in a September 2004 press release stated that "for us, technology is not a mere indulgence or a nice to have. It is at the very heart of our business and helps us drive our multi-channel strategy. Providing customers access to our broad product line through several channels has been a competitive weapon for us because it spells speed and convenience for our customers." He also observed that 60 percent of the company's orders came in via telephone, so the company also upgraded its telephone system to make it simpler to reach people and place orders. The early-phase implementation of SAP resulted in a $115 million reduction in inventory and a 25 percent increase in productivity, so Grainger was finally happy with the system. According to SAP, the system supports 2 million customer contacts, 800,000 products and 115,000 orders per day (SAP Web site).

Grainger has repeatedly been high in the rankings of "Best Places to Work in IT," compiled by Computerworld. In 2010, the company had 586 IT employees (and 13,000 total employees), with a turnover rate of only two percent. It probably helps that James Ryan the CEO was once the CIO at Grainger.

Questions

1. How is Grainger's business different from that faced by Owens & Minor?
2. Why did Grainger's initial Web approach using multiple sites fail?
3. Grainger's problems implementing its ERP system are often cited for being unusually severe. Why did Grainger experience so many problems?
4. How does Grainger support local stores as well as online sales? Why is that approach successful for Grainger but not for Dell?

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Case: Univar: Van Waters & Rogers

Van Waters & Rogers is a respected name in the chemical supply industry. Established in Seattle in 1924 by George Van Waters and Nat S. Rogers, the company grew through acquisitions to become the largest wholesale provider of chemicals in the United States and Canada. Through international mergers, the company is also a major (but not the largest) supplier in Europe. In 1973, the company changed its official name to Univar, but kept the esteemed Van Waters & Rogers name on its local units. In 1986, the company acquired McKesson Chemical to extend its reach across the United States. Starting in 1991, the company began a series of mergers and acquisitions in Europe, forming Univar Europe. The rest of the chemical supply industry was consolidating at the same time. In 1996, Royal Pakhoed, a major worldwide player in liquid chemicals, purchased the shares of Univar it did not already own. In 1999, Royal Pakhoed merged with its major competitor (Royal Van Ommeren) and created Royal Vopak. The growth continued with the purchase of Ellis & Everard in 2001, giving Vopak a substantial market share in the United Kingdom and Ireland. However, with the global economic downturn after 2001, all chemical suppliers were suffering. In 2002, Vopak spun off the chemical and distribution assets and reestablished Univar as an independent company. Univar is a Dutch company, listed on the Euronext Amsterdam stock exchange as UNIVR. Its headquarters is in Rotterdam, but major administrative offices remain in Bellevue, Washington (company history Web site).

Largely because of the economic recession of 2003 and the high prices for oil (a major ingredient for many chemicals as well as a factor in transportation costs), all of the major chemical suppliers have suffered. Analysts estimate that Vopak has invested about $1 billion in Univar. Shortly after stock was issued in the new Univar company, its shares fell to €5.6, which gave the company a valuation of only about €150 million, less than one-fifth of that billion dollars (Tilton 2002).

Univar has progressed through considerable turmoil with the various mergers and the flat economies. In the early 1990s, the company tried to centralize management and run its distribution centers using a hub-and-spoke system. Analysts have pointed out that the system worked poorly and sales suffered. With the purchase by Vopak, the Van Waters & Rogers division was moved back to a decentralized approach, with more responsibility pushed to regional directors and a focus on specific product segments. In the late 1990s, the company moved more operations out to multiple local warehouses (Morris 1996). The multiple acquisitions during the late 1990s and early 2000s did not really help sales in the short run. Managers and investors faced huge uncertainties about what was going to happen next.

Initially, splitting the company back from Vopak appears to have helped. Sales for 2003 increased 9 percent to 1.62 billion eruos. However, much of that gain was due to currency effects from the 40 percent Euro appreciation. (In the chart at the top of this section, Univar's sales have been converted to dollars using a single exchange rate to eliminate the exchange-rate effects.) Sales in North America were flat and hampered by the manufacturing slowdown and the rise in oil prices (Van Arnum 2003). A key step in the mergers was to consolidate the European operations under a single brand. Managing the company globally instead of regionally is a second imperative. As part of Vopak, the strategy had been to balance regional storage with distribution. John Phillpotts, president of Univar Europe, notes that "we never operated commercially as a global business before. For the last 18 months, we've had no distractions about where the company is going or who's going to own it. Chemical distribution is all we talk about now" (Young 2004).

In 2007, Univar began the process of selling to CVC Capital Partners, a London-based private equity firm (Berman 2007). In 2007, Univar acquired CHEMCENTRAL Corporation and expanded into new industries including coatings, personal care, and cleaning. Univar servers more than 250,000 client customers worldwide and leads the industry in chemical distribution (2006 Annual Report). Much of Univar's profit margins come from processing, packaging, and distribution. Most of the inventory turns over every 40 days. Most of the costs are fixed, particularly tied up in processing and storage facilities such as the 160 distribution centers in the U.S., Canada, and Europe. Net sales in 2006 were $6.6 billion with a net income of $134 million. For four years, sales grew at an 11 percent compound growth rate and earnings grew at 21 percent due to declining costs (2006 Annual Report). Net sales in 2009 were $7.2 billion and Univar had 179 distribution facilities and 6,900 employees around the world (Web site/annual report). The company continued its acquisition of smaller distributors in Europe.

E-Business

Univar has followed two approaches to e-business. The company is part of the consortium that drives Elemica, the chemical industry Web site. Univar also runs its own B2B Web portal, ChemPoint. The ChemPoint site is also designed to support smaller chemical manufacturers and highlight new products. In particular, the site is aimed at providing distribution services to chemical producers. Customers place orders through the site, and Univar handles the distribution—linking electronically to Yellow Transportation, its main less-than-truckload (LTL) carrier. Chad Steigers, managing director of ChemPoint.com, notes that there are still some difficulties getting companies to adopt electronic transactions. The goal of many firms is to increase productivity. His firm is looking to more technology to encourage the use of e-business. "We think, for example, RFID will be a major factor especially in the chemical arena" (Cottrill 2003). Ultimately, buyers should be able to place an order, and then track it all the way through shipping, storing, and delivery.

ChemPoint focused on ensuring a broad market by signing up at least one supplier for each type of chemical, with the goal of providing buyers with a dependable source. Reliability and reduction of search costs are important factors for many of the hard-to-find chemicals (Cuny 2001).

When the ChemPoint site was started, it faced intense competition. As Chad Steigers, managing director, pointed out in 2000, "There are 25 trading companies that offer auctions of chemicals. We think that will drop down to two or three." At the time, the Web site had 127 customers and sold 1.3 million products provided by 2,200 suppliers, amounting to $24 million in transactions a year (Seideman, 2000). The emphasis on specialty chemicals and distribution are key elements that have kept the site active today. Steigers observes that "e-distribution is a new segment for the industry. We're the only ones focused on the less-than-truckload segment of the specialty and fine chemicals market, which is about a $70-billion/year niche" (Fuller 2000).

Univar also participates in Elemica, an electronic marketplace for the huge chemical producers and distributors. The site was set up at the end of 2000, primarily to facilitate long-term contracts. It was also designed to assist firms with financing and transportation issues. The decision to avoid spot market auctions was probably due to the competing systems already in development (most of them have since failed) (Rosencrance 2000). Because of the emphasis on large sales, Elemica is emphasizing the ability to connect ERP systems between buyers and sellers. Larger purchasers can transmit orders, receive confirmations, and transfer the data directly into their accounting ERP systems (www.elemica.com).

Univar also runs specialty Web sites for certain uses. For instance, the pestweb.com site is used to provide information and sell products to pest and weed control companies. To provide wider access to data and ordering, the site created an iPhone app to provide information on products and the industry. It enables large and small firms to obtain data and order chemicals directly from their nearest Univar provider (pestweb.com).

The company also wants to build in more relationship-based features to its Web sites. The goal is to help customers find related information and products that might be useful to them. As CIO Cummings points out, it is challenging for customers to understand the full breadth of products provided by Univar, so "If we knew a bit more about what the customer does, we could direct them towards more of our capabilities" (Beacham 2010).

Internal Network Technologies

The global nature of Univar makes it more difficult to manage the company. Even across the United States, the battles between centralization and decentralization led to sales problems. Dealing with multiple offices around the world, in a company that now sees itself as a single global entity, can be difficult and expensive. To improve communications without increasing travel costs, Van Waters & Rogers turned to PlaceWare's hosted collaboration system (now owned by Microsoft and renamed LiveMeeting). The system provides voice and video to any desktop that is connected to the Internet. It also has shared drawing boards, chat facilities, and the ability to show slides. It can also store a presentation for later playback if some people cannot make the initial meeting. In one example, Van Waters & Rogers used it for a strategy meeting between a team in North America and one in Switzerland to discuss a product rollout (Agnew 2000). The system is also used for training and general meetings. Ron Miazga, the human resources training director, notes that the system has been well-received and cost effective. However, building training sessions takes some practice, since "you have to make the presentations very media intensive. You should ask a polling question every three to five minutes. You have to change the screen every minute or so to hold their attention" (Agnew 2000).

In 2006, Univar signed with Odyssey Logistics to handle in-bound deliveries including transportation and management. Odyssey claims that one reason for the strategic alliance was the power and capabilities of its Global Logistics Platform software (OdysseyLogistics.com). The software integrates with commercial and private carriers of rail and trucks to provide scheduling and tracking. It also determines rates, availability, and scheduling over the Web. Outsourcing these operations simplifies management and provides capabilities that Univar would not be able to create by itself.

Around 2007, Univar replaced its IBM computers with an IBM System z9 enterprise system because of the high growth rates and increased server loads. The company's custom ERP system was designed and built to run on IBM large computers and the company needed a new system that could expand and grow with future needs. The system can also run virtual Linux servers which could be used to reduce the number of physical servers Univar runs.

In 2010, Univar hired Dave Cummings as a new CIO. His main experience was with ConocoPhillips as a program manager with SAP applications (press release). Univar has an online ordering system that supports standard ordering, and tracking, as well as material safety data sheets (MSDS).

Questions

1. Why does decentralization at Univar require more use of networks?
2. Why does Univar pursue a multiple-site e-commerce strategy, and why does it work for Univar and not for Grainger?
3. Why are some customers reluctant to adopt electronic ordering for chemicals?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 4

Database Management

Chapter Outline

What You Will Learn in This Chapter

- How do you store and retrieve the vast amount of data collected in a modern company?
- How do you ensure that the transaction data is accurate?
- Why is the database management approach so important to business?
- How do you write questions for the DBMS to obtain data?
- How do you create a new database?
- How do you create business applications using a DBMS?
- What tasks need to be performed to keep a database running?
- Why are databases so important in e-business?
- How are databases used in cloud computing?

Eli Lilly and Company

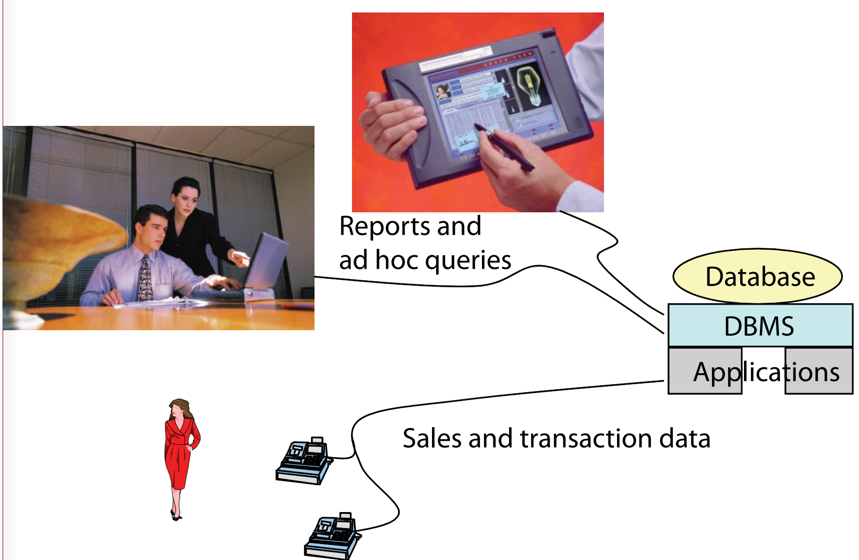
How do you store and retrieve huge amounts of data? Eli Lilly is a giant pharmaceutical company. Creating new drugs requires enormous efforts in research. Getting drugs approved takes years and dozens of lawyers. Except for the occasionally unique blockbuster, selling a drug requires delicate, but expensive, marketing. All three areas benefit from the use of information technology, particularly database systems. Evaluating chemicals, searching the huge database of existing results, and tracking progress generate huge amounts of data and require sophisticated analytical systems. Tracking clinical trials, the paperwork, and the progress of drugs through various agencies requires nontraditional databases and support. Marketing is a relatively new area for pharmaceutical companies, and they are still looking for ways to sell such complex products. Sometimes problems arise, such as when Lilly accidentally included the e-mail addresses of 669 subscribers to its prozac.com service in a message to 700 users.

Introduction

How do you store and retrieve the vast amount of data collected in a modern company? Airlines have a difficult problem: they need to track every seat and passenger on every flight. Thousands of people might be trying to book the same flight at the same time, but the system can never sell the

Figure 4.1

Without a DBMS, data can be scattered throughout the company, making it more difficult to share information. Inconsistent data, duplication and errors are common. A DBMS collects data from many sources and maintains data through a common interface. Data definition, access, consistency and security are maintained by the DBMS.



Trends

In the 1960s and 1970s, companies typically built their own transaction-processing systems by writing programs in COBOL. These programs consisted of millions of lines of code. Each program created and used its own set of files. As companies expanded, more programs were created—each with its own format for files. Whenever a manager wanted a new report or additional information, a programmer had to modify the old code or create a completely new program.

A database management system (DBMS) presents a different approach to data, reports, and programming. The most important task is to define and store the data so authorized users can find everything they need. Report writers and input screens make it easy to enter data and create reports without relying on programmers. Data is stored in a special format so that it can be shared with multiple users.

In the early 1970s, E. F. Codd created a flexible approach to storing data, known as the relational model, that avoided these problems. Today, relational databases are the dominant method used to store and access data. Relational databases have a query system that enables managers to get answers to questions without relying on programmers.

Early databases were designed to handle business types of data, such as customer names and account data. Some modern database systems can store entire books, pictures, graphs, or even sound clips as types of data. A few companies are working on object-oriented DBMSs that enable users to create their own data types and continue to manipulate and search the data.

same seat to different people. Many other business problems have similar characteristics. All of the accounting and payroll data, sales, and purchases have to be saved for any company. Database management systems were specifically designed to solve these problems. As shown in Figure 4.1, the primary elements of a database system are to collect and store data, produce reports, and provide data to answer business queries. Today, database systems form the foundation of almost every business application. What database features do you need as a manager? How can you retrieve the data stored by the system? How can you create reports?

A **database management system (DBMS)** is one of the most important tools in business and MIS. The systems have changed the way that computer applications are developed, and they are changing the way that companies are managed. The database approach begins with the premise that the most important aspect of the computer system is the data that it stores. The purposes of a database management system are to provide shared access to the data, answer questions, and create reports from the data.

A crucial factor with databases is that they can become massive. Several companies such as American Express and UPS have indicated that their databases contain several terabytes (trillions of bytes) of data. Even small companies deal with databases with megabytes (millions of bytes) of data. The size of the database greatly affects its performance and the ability of users to find the data they need. Large databases need to be designed and maintained carefully to ensure that they run properly.

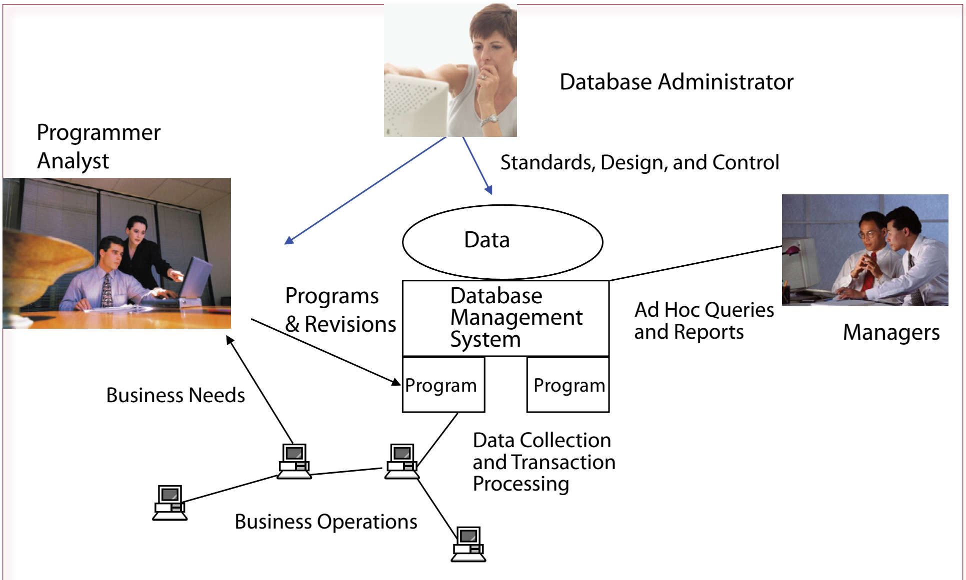


Figure 4.2

MIS employees and databases. The database administrator is responsible for defining and maintaining the overall structure and data. Programmers and analysts create applications and programs that collect data and produce reports. Business operations generate data that fills the database. Managers use the application programs and ask ad hoc questions of the data.

Another important characteristic of databases is that they are designed to help users examine the data from a variety of perspectives. Instead of simply printing one type of report, they enable users to ask questions and create their own reports. Figure 4.2 illustrates how a DBMS is used in an organization. It collects data for transaction processing, creates reports, and processes ad hoc queries for managers. Figure 4.2 also indicates that databases usually require programmers to define the initial database and maintain programs to perform basic operations. The overall design is controlled by the database administrator.

A DBMS is complex software that can be purchased separately or it can be embedded into an application. The primary vendors are Oracle (Oracle DBMS), IBM (DB2), and Microsoft (SQL Server). A few open-source systems also exist, led by MySQL and PostgreSQL. Today, MySQL is largely controlled by Oracle. The open source tools generally can be acquired at low or no cost; however, technical support or maintenance contracts can be purchased. Without the support contract, you would need skilled developers and administrators to handle all of the support tasks. Microsoft Access is commonly available with the Office suite, but it is limited to relatively small projects. Also, Microsoft is encouraging developers to switch to SQL Server.

Relational Databases

The goal of a relational DBMS is to make it easy to store and retrieve the data you need. All data is stored in **tables**, which consist of **columns** with **rows** of data. Each table has a name and represents objects or relationships in the data. For instance, most businesses will have tables for customers, employees, orders, and inventory.

Customer Table

CustomerID	Name	Address	City
12345	Jones	125 Elm	Chicago
28764	Adamz	938 Main	Phoenix
29587	Smitz	523 Oak	Seattle
33352	Sanchez	999 Pine	Denver
44453	Kolke	909 West	Denver
87535	James	374 Main	Miami

Sales Table

SaleID	CustomerID	Date	Salesperson
117	12345	3/3/09	887
125	87535	4/4/09	663
157	12345	4/9/09	554
169	29587	5/6/09	255

Figure 4.3

Creating table definitions. Tables are defined so that they can be linked by common columns. For a given row in the Orders table, you can find the corresponding customer data by locating the row with the matching phone number. In practice, this matching is handled by the DBMS query system.

Besides storing data, a modern DBMS has several useful tools. Input screens are built to help users enter data. Reports can be created by laying out data, text, and graphics on the screen—often with no programming. You can get answers to questions with a query language or even by pointing to tables and data on the screen. You can establish security conditions by granting or denying access to portions of the data. Most systems include an application generator that can tie input screens, queries, and reports together with a menu system. A complex application can be created by typing a few titles on the screen, without writing a single line of traditional program code.

Tables, Rows, Columns, Data Types

If you understand how spreadsheets work, it is easy to comprehend relational databases. A single spreadsheet consists of rows and columns of data. Each column has a unique name, and a row contains data about one individual object. A database consists of many of these tables that are linked by the data they contain.

In a database, each table contains data for a specific entity or object. For example, most companies will have a table to hold customer data. There are certain attributes or characteristics of the customers that you want to store. In Figure 4.3, each customer is assigned a unique CustomerID and has a name, address, and city. In practice, there will be more columns.

Figure 4.3 also illustrates one of the most important features of a database system: Relational databases are specifically designed to allow many tables to be created and then combined in interesting ways. If you had only one table, you could use a spreadsheet or virtually any filing system, assuming it could handle the num-

> **Reality Bytes: Database Terminology**
> When E. F. Codd created the relational database model, he deliberately introduced new terms to describe the way that databases should store information. His terms are attribute, tuple, and relation. Although Codd's terms are precisely defined mathematically, they can be confusing. As a result, many people use the slightly easier words: column, row, and table. Before relational databases, several different terms were used to refer to the various parts of a database. The problem is that many of the terms had several definitions. Common terms include field, record, and file. You should avoid these terms.

ber of rows you needed. However, most business problems involve data stored in different tables. In the example, customers can place many different orders. Each order is stored in a separate line in the Orders table.

Notice that the tables are joined or linked by the CustomerID column. The CustomerID is the **primary key** column in the customer table. Each row in a table must be different from the rest; otherwise, it is a waste of space. Consequently, each table must have a primary key. A primary key is a set of one or more columns that uniquely identifies each row. If someone gives you a key value (e.g., 12345), you can immediately locate the appropriate row and find the rest of the data for that entity (name, address, city).

Each primary key value must be unique, but that is hard to guarantee with most common identifiers. In some cases, you might use phone numbers, but what happens if a customer moves and gets a new phone number? In most cases, it is safest to have the computer generate identifier values that are guaranteed to be unique. However, do not expect customers (or salespeople) to memorize these numbers. The identifiers are simply used in the database to ensure there is a way to separate customers. You can always use names or phone numbers to look up other data for customers.

More complex tables require multiple columns to identify a row. These keys are called **composite keys**. They represent many-to-many relationships. For example, a typical order system requires an OrderItem table that contains two columns as keys: OrderID + ItemID. Both columns are keyed because many items can be ordered at one time (so ItemID is keyed), and an item can be ordered at many different times (so OrderID is keyed).

Unlike a spreadsheet, each database column can contain only one type of data at a time. For example, in the Date column you can store only dates. You would not be allowed to put names or totals in this column. Most relational databases were designed to hold business types of data. The basic choices are text, dates (and times), numeric, and objects (graphics, video, and sound). Some systems enable you to be more specific about how to store numeric data. For instance, you might want to store data with only two decimal places for monetary values. Whenever possible, dates should be stored in a date format instead of text. That way you can perform arithmetic on the values. For example, a formula like (today + 30) could be used to find a due date that is 30 days from today.

Data Quality

How do you ensure that the transaction data is accurate? Transaction-processing systems can become quite complex. Problems are going to oc-

> **Reality Bytes: The Government Pays Dead People**
> It can be hard to track the almost 2.5 million people who die each year in the United States. Over three years, the federal government sent $180 million worth of benefit checks to 20,000 people who had died. Although the Social Security Administration maintains a database of people who have died, it was not routinely shared with other agencies. The White House Office of Management and Budget also noted that over three years, checks valued at $230 million were sent to 14,000 convicted felons—some in jail, some still running. Although the General Services Administration maintains an "Excluded Parties List System," few agencies actually check it for ineligible contractors. Of course, these numbers are dwarfed by the $65 billion in erroneous payments made in a single year through the Medicare and Medicaid programs. Still, the government is working on building a comprehensive database that will make it easier for agencies to verify status before checks are sent out.
>
> Adapted from *The Wall Street Journal*, "Database Aims to Prevent Uncle Sam From Paying Dead," June 18, 2010.

cur in any system—especially because all business organizations change over time. That means the computer system has to change to match the business. It is virtually impossible to change the system at exactly the same time as the business, so problems will occur. Other problems arise simply because the systems are so complex. Many processes involve humans who make mistakes. If you understand what types of problems might arise, they will be easier to solve.

Data Integrity

One of the most important concepts in information processing is the issue of data integrity. **Data integrity** means keeping data accurate and correct as it is gathered and stored in the computer system. There is little value in an information system that contains out-of-date or inaccurate data. A common complaint among shoppers today is that stores using bar-code scanners might have a different price in the computer than the amount displayed on the shelf. It is easy to change prices in the computer; it is more difficult to change the signs in the store. Shoppers will feel cheated if the computer tries to charge them a higher price than the amount listed on the shelf. Some states, such as Michigan, have passed laws requiring that the scanned price cannot be higher than the amount listed on the package or display. Similar errors cause problems when the computer shows more items in stock than actually exist.

The first step to ensure data integrity lies in its capture. Each item must be correctly entered and the complete information recorded. It is sometimes possible to check the data as it is entered. Item code numbers usually include a check number that is based on the other digits. In the item code 548737, the first five digits add up to 27, so the number 7 is included as the last digit. If the person or machine makes a mistake entering one of the digits, they will probably not add up to 7, so the computer can immediately determine that there is an error. Sophisticated methods exist to catch mistakes involving more than one digit.

Even with machine entry of data, validity problems can arise. What happens when a shipment arrives but the receiving department forgets to record it? The same problem occurs when a clerk holds an item for a customer and does not re-

Transaction A	Customer Accounts Sanchez: Balance	Transaction B
1. Receive 300 payment 2. Read balance (500)	Sanchez: 500	
		3. New purchase (350) 4. Read balance (500)
5. Subtract payment 6. Store new results (200)	Sanchez: 200	
	Sanchez: 850	7. Add purchase 8. Store new result (850

Figure 4.4

Concurrency and data integrity. Multiuser and multitasking systems can cause problems with concurrent changes to data. Two processes cannot be allowed to change the same data at the same time. A key strength of a DBMS is that it is built to handle these problems with minimal effort.

cord it in the computer. Data integrity can be destroyed by indiscriminately allowing people to change the numbers in the computer. It is one of the main reasons for creating secure computers and controlling access to each piece of information.

Multitasking, Concurrency, and Integrity

A useful feature offered by more sophisticated operating systems is the ability to perform more than one task at a time. In many situations it is useful to have several jobs running at the same time. What happens if you are searching a huge database and your boss calls and asks you for a sales figure? With a multitasking computer operating system, you could switch to a new program, look up the number, and allow the database to continue searching in the background.

If you use a multitasking operating system, it is important that your application software understand that other applications might be running at the same time. Each application needs to protect its data files from concurrency problems. **Concurrency** arises when applications attempt to modify the same piece of data at the same time. If two people are allowed to make changes to the same piece of data, the computer system must control the order in which it processes the two requests. Mixing the two tasks will result in the wrong data being stored in the computer. These problems can be avoided by only using software that was specifically written for multiuser (or multitasking) computers.

Consider the case of a mail-order firm shown in Figure 4.4. On the left side, customer Sanchez sent a payment on his account. At the same time the clerk begins to process the payment, Sanchez calls a second clerk and places a new order. The figure shows what happens if both transactions continue and interfere with each other. What should the final balance be? Does the computer have the correct number?

To solve this problem, the application program must know that several people might try to access the same piece of data at the same time. The software locks out all users except one. When the first process is finished, the other users can try to gain access again. To keep data accurate, applications used by many people at the same time must be written to handle these concurrency problems. Early personal computers were designed for only one user, so much of the software did not prevent concurrency problems. Software designed for computer networks generally handles this issue. When you use this software, you will occasionally receive a message that says a piece of data you desire is currently being used by another person. If you get this message, simply wait for a few minutes and try again. When the first person is finished, you should be able to proceed.

Data Volume

A common problem experienced by a growing business is the increase in the amount of data or data volume. Consider the huge databases handled by Information Resources, which processes data from supermarket checkouts, or United Parcel Service, which tracks every package every day.

As the business grows, there will be an increase in the number of transactions. As the price of a computer drops, more applications are placed on the computer. Additional transactions become computerized. Several problems can be created from this increase: (1) processing overload or system slowdowns, (2) greater difficulty in making sure the data is accurate, (3) insufficient storage within the computer system, and (4) data not captured fast enough.

Visa International processes more than 6 billion electronic transactions a year. By the year 2000, the company was handling 15 billion annual transactions. There are 18,000 banks offering Visa cards, used by 10 million customers. So much data is generated on a daily basis that Visa cannot keep transaction data online beyond six months. All older records are moved to backup storage, making them inaccessible for additional research or decisions.

Sloppy practices and huge datasets can lead to inaccurate data. As the system slows down or the computer runs out of storage space, people avoid using it, so data is no longer up to date. With the increase in volume and the computerization of new types of data, it is more difficult for programmers and managers to check the data. If parts of the computer system are too slow, data may not be captured fast enough. As a result, some data might be lost. A tremendous amount of information is stored in raw data. The raw data could be analyzed to offer new services or improve the quality of existing services. However, the huge volumes require too much storage space and too much processing time.

Careful planning is required to avoid these problems. At best, new computers and storage usually take a month or two to purchase. It could take a year or more to evaluate and purchase a large, expensive central computer. The MIS department would like to forecast the demands that will be placed on the computers at least a year in advance.

The Database Management Approach

Why is the database management approach so important to business? In many ways, the database approach has revolutionized the way information systems function and altered the way businesses operate. Originally, all programs handled their own data in separate files. It took enormous coordination and documentation to try and make the multiple programs work together. The DBMS changes everything by focusing on the data instead of the programs. Its primary purpose is to store and share the data.

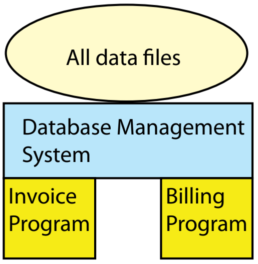


Figure 4.5

DBMS approach. The database management system controls all access to the data. Programs and queries are controlled by the DBMS. Security, consistency, and integrity rules are always maintained by the DBMS.

Focus on Data

The database management approach is fundamentally different from the older programming methods. Whenever someone needs a computer application, the first step is to identify the data that will be needed. Then a database management system is used to store the data. It takes care of storing the raw data, as well as information about that data. Everything you want to know is stored within the DBMS, not in an application program. This situation is illustrated in Figure 4.5. The goal of the DBMS approach is to collect accurate data and make it available to users. The system should also minimize unnecessary duplication of data.

Data Independence

Defining the data separately from the programs is called **data independence**. The main advantage is that it is possible to change the data without having to change the programs. For instance, you might want to add a second phone number to the customer data. With a DBMS, you can make this change, and it will not affect any of the existing programs. Similarly, the reports can be modified without having to change the data. That means when the programmer is called in at 3 A.M., she has to change only one program. All the other programs will be unaffected. Besides making the programmer's life easier, the database is more likely to be accurate and there will be less duplication of data.

Data independence means that the data and programs are separate, which makes it possible to alter the database tables as needed, without destroying the programs. As the business grows, you might decide to collect additional data, such as keeping track of sales by salesperson or by sales route. As the company expands and changes, the underlying tables can be expanded and new tables can be added—without interfering with the existing tables or current programs. Just be careful to avoid deleting tables or removing entire columns. Of course, as the business changes, managers will undoubtedly want to modify the reports to add the new information.

Data Integrity

Data integrity is an important consideration in designing and maintaining databases. Data integrity means that the database holds accurate, up-to-date data. In the airline case, it means not selling the same seat to two different people. If there are

Reality Bytes: Government Databases can be Really Big

Take 130 million people, multiply by every healthcare visit, and every diagnoses and treatment; and you end up with a giant database. As the Federal government increases its involvement in healthcare, it needs to build a giant database to track dozens of aspects of healthcare for individuals and groups. Of course, a giant database raises giant privacy questions. The government says that it can anonymize the data. The goal is to track price and quality patterns to focus on groups and not individuals. Initially, the database will focus on Federal employees, and include the ability to evaluate longitudinal effects—essentially tracking treatments over time. Analysts will have access only to de-identified data. The inspector general's office also plans to use the database to monitor for fraud and waste, which means it needs access to provider information.

Adapted from Jaikumar Vijayan, "Feds Move Toward Health Claims Database Despite Privacy Fears," *Computerworld*, June 16, 2011.

business limits on certain values, the database should force the data entry to abide by those rules. For example, prices will always be positive numbers. Another integrity concept is the importance of identifying missing (null) data. Computations should be able to skip missing data. From a manager's viewpoint, an important integrity design element is naming columns carefully. The columns should have names and descriptions so that the users understand what is stored in the database. If a column is simply labeled *Revenue*, users might wonder if that means revenue from all products, all divisions, the current year, or perhaps just monthly totals. All of this information is stored with the database in the data dictionary.

An important component of database integrity is that the data needs to be consistent. For example, consider a table that describes products for sale. Perhaps the products are grouped into categories (cleaning supplies, paper goods, clothing, etc.). Each item belongs to only one category. What happens if the categories are not entered consistently? The *Cleaning Supplies* category might be entered as just *Cleaning*, or maybe as *Clean Supplies*, or even *Cl Sup*. These variations in the data make it difficult to search the table based on that category because the user would have to know all of the variations. A good DBMS supports rules that can be used to minimize these problems. However, when dealing with databases, it is good practice to be careful when you enter data to ensure that your entries are consistent.

Speed of Development

It is possible to create an entire database application without having to write a single line of traditional programming code. As a result, an application can be built in a fraction of the time it would take to create it by writing COBOL programs. Studies indicate that most systems can be created 10 times faster using a DBMS—if the data already exists in the database. As the commercial database products—such as Oracle, SQL Server, and DB2—continue to add features, they can be used to solve even more complex problems.

Keep in mind that it is possible to use traditional programming tools such as COBOL in conjunction with the DBMS. If complex reports or complicated calculations are involved, it is sometimes easier to use a traditional programming

Four Questions to Create a Query
- What output do you want to see?
- What do you already know (or what constraints are you give)?
- What tables are involved?
- How are the tables joined?

Figure 4.6

Four questions to create a query. You will always have to answer these four questions. In many cases, there will be only one table (or view), so the second and last questions are easy.

language. These programs retrieve the base data from the DBMS and print their own reports or store computed values in the database for later use.

One of the most important steps of developing a solution is to break the problem into smaller pieces. One major piece of any problem is the data. A DBMS makes this portion of the problem easier to solve. By putting the DBMS in charge of maintaining the data, keeping track of security, automatically supporting multiple users, and printing reports, the developer can concentrate on solving the specific business problems. By starting from scratch with COBOL, each of these features would have to be rewritten for every application that was designed, which would be expensive.

Control over Output

Another strong advantage of database management systems is their ability to provide many different views of the output. In fact, a primary objective of the relational database approach is to store the data so that users can retrieve it any way they need. The other feature of databases is that they are designed to make it easy to combine related data. An older programming/file approach generally limits the user to using data in only one way.

With a DBMS, output can be created from report writers, which make it easy to format the data; some systems even draw graphs. The other common method of retrieving data is to use a query language such as query by example (QBE) or SQL discussed in the next section. Queries enable managers to search for answers to questions without using a programmer to write special programs.

Queries

How do you write questions for the DBMS to obtain data? Most of the time, managers work with databases that have been created by someone else. You will need to learn how to retrieve data to answer questions. It might be nice to be able to ask questions in a natural language (such as English), but it turns out to be hard to make computers understand these questions and you might not always be certain that the answer is what you asked for. A DBMS provides at least one method of asking questions and retrieving data. Two common methods are QBE and SQL. **SQL** is an international standard method for retrieving data from database management systems. It is supported by most of the major commercial relational database management systems. By the way, according to the standard, the name SQL is just three letters and not an acronym. **QBE** stands for **query by example** and is a visual method of examining data stored in a relational database.

Customers

CustomerID	Name	Phone	City	AccountBalance
12345	Jones	312-555-1234	Chicago	197.54
28764	Adamz	602-999-2539	Phoenix	526.76
29587	Smitz	206-676-7763	Seattle	353.76
33352	Sanchez	303-444-1352	Denver	153.00
44453	Kolke	303-888-8876	Denver	863.39
87535	James	305-777-2235	Miami	255.93

Figure 4.7

A sample table for customer data. CustomerID is the primary key and is used to uniquely identify each customer.

You ask questions and examine the data by pointing to tables on the screen and filling in templates. Queries can only answer questions for which you have collected the appropriate data.

Regardless of the method used to look up information in a database, there are four basic questions you will answer, as listed in Figure 4.6. It does not matter in which order you think of the questions. With some methods (such as QBE), it is easier to choose the tables first. With other methods (such as SQL), it is sometimes easier to choose the output first. In many cases, you will switch back and forth among the four questions until you have all of the components you need. As you learn more about databases, keep these four questions handy and write down your answers before you attempt to create the query on the DBMS.

Single-Table Queries

Consider a simple customer table that contains columns for CustomerID, Name, Phone, Address, City, State, and AccountBalance. Each customer is assigned a unique number that will be used as a primary key. The AccountBalance is the amount of money the customer currently owes to our company. The table with some sample data is shown in Figure 4.7. The tables in these examples are intentionally small to make it easier to understand the concepts. A real table of customers would contain more columns and thousands of rows of data. But the basic concepts will remain the same. Each column represents some attribute or characteristic. Each row holds data for a single customer. The CustomerID is the primary key for this table and it must always be a unique number. In this example, the ID was randomly assigned by the marketing department when a customer was added to the database. It is more common to have the DBMS generate unique ID numbers, but you have to remember that the values are often random.

Query by Example

Query-by-example systems that were designed for graphical user interfaces (GUIs) are especially easy to use. Microsoft's Access illustrates a common approach. The basic mechanism is to make selections on the screen—typically by pointing to them with a mouse. You then fill out a template like the one shown in Figure 4.8. Note that Access has several ways to create queries. The Design (or

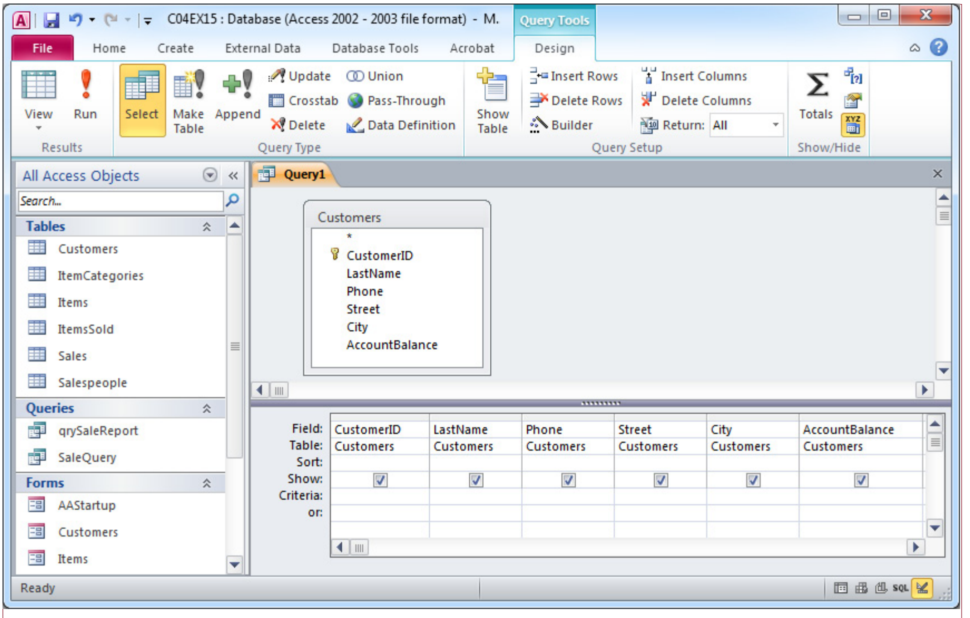


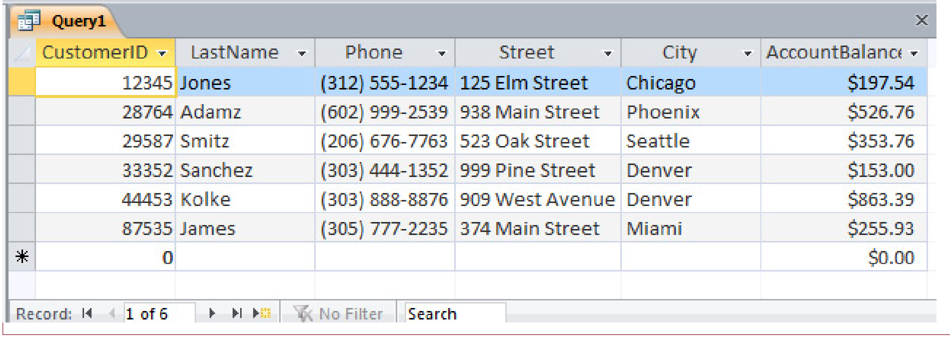
Figure 4.8

Design: List all of the customers. First select a table, then drag columns you want to see onto the grid. Checking the Show box ensures that the column will be displayed when the query is run.

QBE) approach is probably the easiest to learn. The Wizard is not very useful. You should also be able to read the text SQL statements, which are shown later in this chapter. In the end, the query systems are basically the same. You must always answer the four basic questions: (1) What output do you want to see? (2) What constraints are you given? (3) What tables are involved? (4) How are the tables joined together? This section focuses on a single table and saves the complications of the last two questions for later.

Figure 4.9

Results for the query that selects all rows of the Customers table.


Query1

CustomerID	LastName	Phone	Street	City	AccountBalance
12345	Jones	(312) 555-1234	125 Elm Street	Chicago	$197.54
28764	Adamz	(602) 999-2539	938 Main Street	Phoenix	$526.76
29587	Smitz	(206) 676-7763	523 Oak Street	Seattle	$353.76
33352	Sanchez	(303) 444-1352	999 Pine Street	Denver	$153.00
44453	Kolke	(303) 888-8876	909 West Avenue	Denver	$863.39
87535	James	(305) 777-2235	374 Main Street	Miami	$255.93
0					$0.00

Record: 1 of 6 No Filter Search

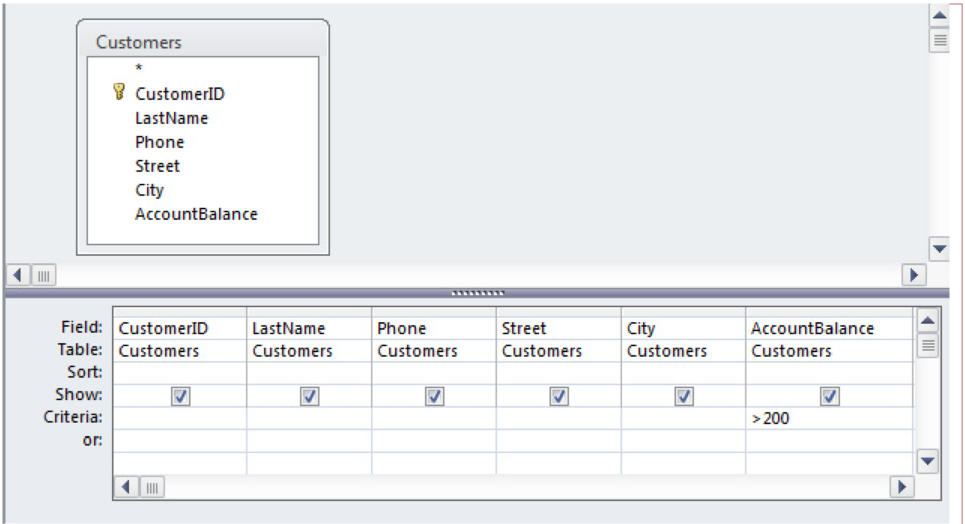


Figure 4.10

Design query. List the customers with an AccountBalance of more than $200. Results of the query can be sorted in Ascending or Descending order. Multiple levels of sorts are created by selecting additional columns. You will use multiple column sorts when the first column contains several identical values. For example, sort by City, Name.

The Design view or QBE approach begins by asking you a hard question first: Which tables are involved. Fortunately, you can add tables later, so it is usually best to focus on one table at a time. For now, you can start a new query and choose the Customers table. Your next step is to decide what columns you want to see in the results. In this case, drag the CustomerID, Name, Phone, City, and AccountBalance columns onto the grid. You can drag multiple columns at a time, double-click a column name, or select it from the drop-down list on the top of the grid. It does not matter how you get the column name in place, as long as it is in the list and the Show checkbox is set, data will be displayed for that column.

Figure 4.11

Rows that match the conditions. It is easy to check that the AccountBalance is larger than 200 in each row. Even if your query has more rows, you should check random rows to ensure you entered the conditions correctly.

	CustomerID	LastName	Phone	Street	City	AccountBalance
	28764	Adamz	(602) 999-2539	938 Main Street	Phoenix	$526.76
	29587	Smitz	(206) 676-7763	523 Oak Street	Seattle	$353.76
	44453	Kolke	(303) 888-8876	909 West Avenue	Denver	$863.39
	87535	James	(305) 777-2235	374 Main Street	Miami	$255.93
*	0					$0.00

Record: 1 of 4 No Filter Search

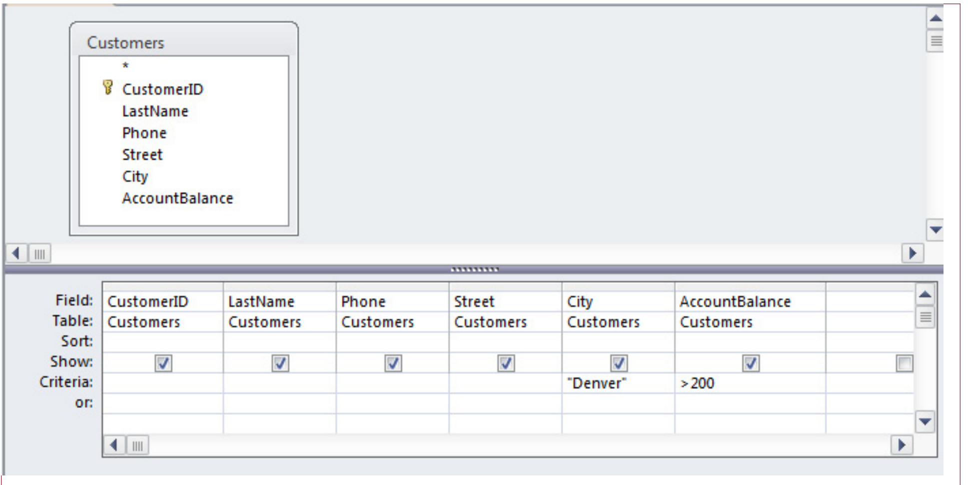


Figure 4.12

List the customers from Denver with an AccountBalance of more than $200. Conditions entered on the same row are joined with an And. Conditions on different rows are connected with a logical Or.

You can run the query by selecting the DataSheet view or by clicking the Run button. For most queries, the DataSheet view is more convenient because you often want to select the Design view to return and edit the query. Figure 4.9 shows the results of running the simple query that selects all of the rows in the Customers table. If you ever want to copy the rows into a spreadsheet or some other document, you can click the small gray square at the top-left of the results to select all of the rows and columns. Selecting the Copy option will put the results onto the clipboard.

Most of the time, you will want to see only some of the rows of data. For instance, you want a list of customers who owe you the most money. You decide to restrict the listing to customers who have account balances greater than $200. With QBE, you enter the appropriate restriction in the criteria row under the desired column as shown in Figure 4.10. Look at the figure carefully and check the greater-than sign. You read the condition as: AccountBalance > 200. You can think of this condition as a filter on the rows that will be displayed. Only rows that meet the specified conditions will be displayed.

Figure 4.11 shows the results of running the query. Double-check the data to ensure that all of the rows meet the condition you specified. Checking your results is a good habit to learn. One of the trickiest aspects of queries is that the DBMS will almost always return something—but you need to verify that the rows it returns are actually the rows that you want to see.

You can specify other conditions for the other columns. Placing them on the same row means they will be interpreted as AND conditions. If conditions are placed on separate rows, results will be computed for rows that match at least one of the criteria (OR condition). Figure 4.12 shows the QBE screen, which tells the DBMS to display the ID, City, and AccountBalance for customers who live in Denver and have account balances of more than $200.

CustomerID	LastName	Phone	Street	City	AccountBalance
44453	Kolke	(303) 888-8876	909 West Avenue	Denver	$863.39
0					$0.00

Record: 1 of 1 No Filter Search

Figure 4.13

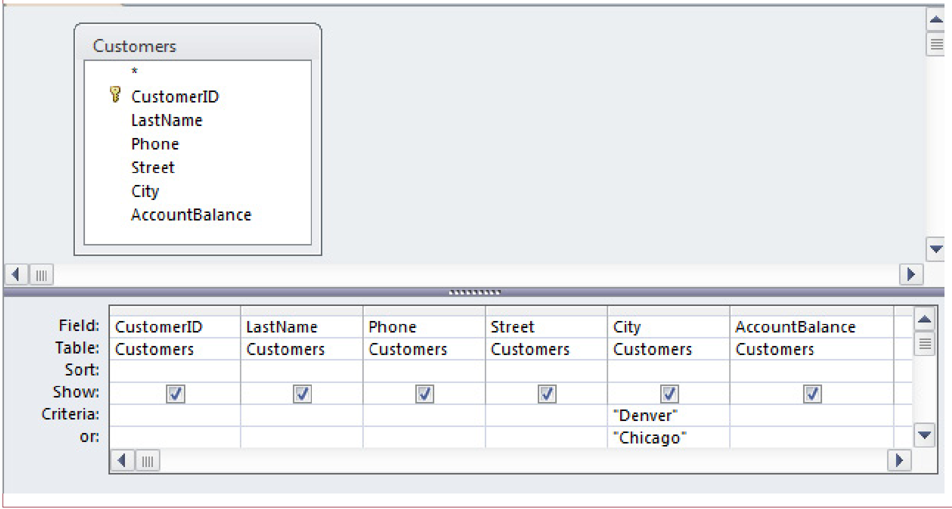
Rows that match the conditions. To be displayed, all of the conditions on the row must be true. In this case, only one customer is from Denver and owes more than $200.

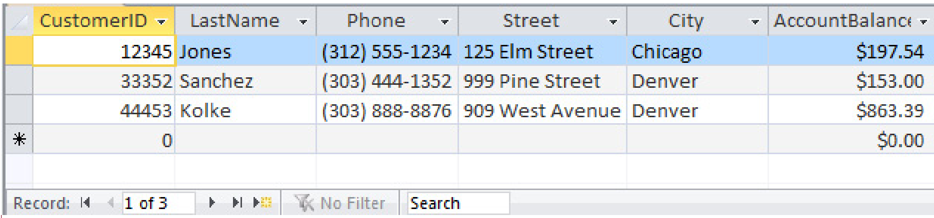
As shown in Figure 4.13, the AND condition creates a filter so that rows are displayed only if they match all of the conditions on that row. In this example, the customer must be from Denver and owe more than 200. Because of the small number of customers, only one person meets both conditions. But, you begin to see the value of using conditions to limit the rows you want to see. Many businesses have huge databases, and it is impossible to search through the data by hand. You can use a simple query to quickly find the rows that match almost any set of conditions.

AND conditions are used to narrow a search. Each time you add an AND condition, you are creating one more hurdle that a row must meet to be displayed. Sometimes you need to widen your search. In these cases, you use OR conditions to impose an alternate set of criteria. Figure 4.14 shows the query for searching for customers who live in either Denver or Chicago. Notice that there is no AccountBalance condition. If you wanted to add the AccountBalance condition,

Figure 4.14

List the customers from Denver or Chicago. Conditions entered on different row are joined with an Or, which widens the search because rows need to match only one of the conditions.





CustomerID	LastName	Phone	Street	City	AccountBalance
12345	Jones	(312) 555-1234	125 Elm Street	Chicago	$197.54
33352	Sanchez	(303) 444-1352	999 Pine Street	Denver	$153.00
44453	Kolke	(303) 888-8876	909 West Avenue	Denver	$863.39
* 0					$0.00

Figure 4.15

Rows that match the Or condition. Customers are displayed who either liven in Denver or Chicago.

you would have to enter it onto both of the criteria rows. With multiple condition rows, the query processor tests to see if a row meets all of the conditions on one row to decide whether to display it. If you were to put the AccountBalance>200 condition only on the Denver row—it will apply only to customers who live in Denver. All of the Chicago customers would be displayed—regardless of their AccountBalance.

Figure 4.15 shows the list of customers who live in Denver or Chicago. Again, it is important to check the results to ensure that you entered the conditions correctly. If you accidentally enter the conditions with an AND clause by putting them on the same row, you would not get any matches. In this database, no customer can live in both Denver and Chicago at the same time.

It is also easy to sort the results. For example, you probably want to which customer owes the most money. Instead of trying to find just one customer, businesspeople often want to see the list sorted by the AccountBalance. That way, if two people owe close to the same amount, they will both be displayed. Figure 4.16 shows that you can sort the results simply by selecting the sort-order in the Sort row. In this case, you want to sort the data in descending order (high-to-low) so that the customers who owe the most money are displayed at the top of the list. Create and run the query to see which person ends up on top.

You will also encounter situations when you need to sort by multiple columns. Names are the most common example. In an English-speaking nation, your database might contain many people with the last name Smith. If you sort only by last name, the rows will still be difficult to read. Instead, you should sort by LastName and FirstName. The one catch in QBE systems is that you need to display the LastName column to the left of the FirstName column so that the query sorts first by LastName, followed by FirstName.

SQL

Another method of retrieving data from a DBMS is with the query language SQL. Although some people find SQL more difficult to learn, it has two advantages. First, it is a standard language that is supported by many different database systems, so the commands will work the same in many situations. Second, it is easier to read than QBE, so it is easier to understand your queries. It is also simpler to write down on paper because it relies on words instead of pictures or layout. Keep in mind that SQL requires the same answers as QBE—the main difference is that you have to type all of the column names instead of dragging them into place.

SQL is a moderately complex language. Fortunately, this chapter uses only a few simple SQL statements. You can take a database class to learn more SQL

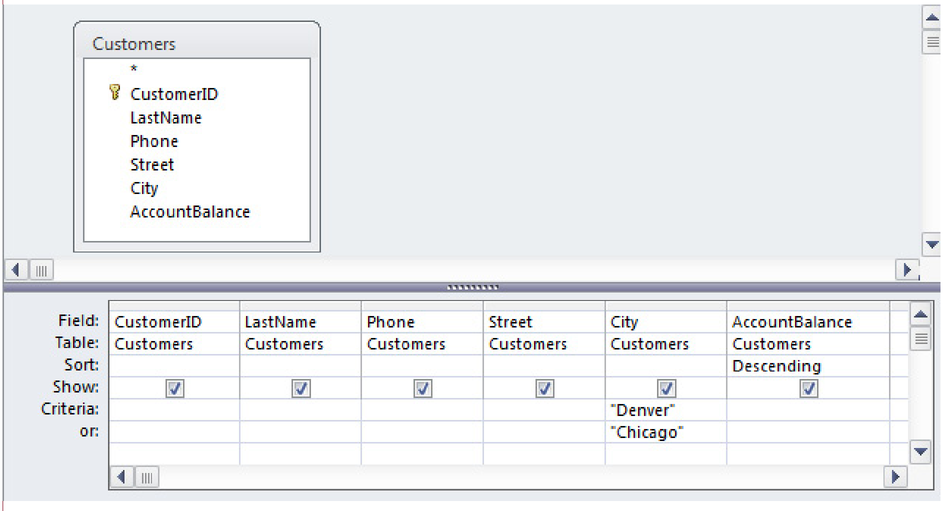


Figure 4.16

Sorting the results. Select Ascending or Descending on the Sort row for the column that needs to be sorted.

details and understand the true power of the language. If SQL seems complex, remember that it is considerably easier than trying to write programming code to retrieve the data. It is even much simpler than trying to build a spreadsheet to find the answers.

The standard command for retrieving data in SQL is SELECT. To be clear, SQL command words in this book will be written in capital letters with tabs to separate the words, but you can type them into the computer as lowercase. The simple form of the command is shown in Figure 4.17. The five parts are written on separate lines to make the command easier to read. One of the benefits of SQL is that you can write down the keywords and then fill in the blanks in any order. Typically, you can start with the list of columns to display and then fill in the conditions. From these two lines you can figure out exactly which tables are needed.

In most cases, the best approach is to decide which columns you want to see. When you read a business question, think about the values that you want to see that would answer the question. For example, if you want to see a list of customers that meet some condition, you want the final result to include at least their FirstName, LastName, and possibly the phone number or address. These columns can be listed in whatever order you want. The column names should be separated by commas. If you want to see all the columns, you can use the key word ALL or an asterisk (*). This approach (SELECT *) reduces the typing, but often results in a huge number of columns. But it is also useful if you cannot remember the names of the columns or how they are spelled.

To illustrate the power of SQL, try creating a simple query to list all of the columns and all of the rows from the Customers table. Figure 4.18 shows the query you want to enter. Microsoft Access supports SQL. In fact, all of the QBE queries you build are actually converted to SQL. Start a new query in Access and choose Design view. Do not add any tables. Click the SQL button to switch to SQL text mode. Type the SELECT command shown in the figure and run the query. You

```
SELECT      columns
FROM        tables
JOIN        matching columns
WHERE       conditions
ORDER BY    column {ASC | DESC}
```

Figure 4.17

The SQL SELECT command. This command is used to retrieve and display data. It is the foundation of many of the other SQL commands.

will receive an error message if you type one of the words incorrectly, such as forgetting the "s" in Customers. The results are similar to those in Figure 4.10, but also include the Street column.

Next, you need to know the name of the table. The SQL command to retrieve all of the customer data is SELECT * FROM Customers. The result can be sorted by adding the ORDER BY clause. For example, SELECT * FROM customers ORDER BY City.

To get a list of customers who live in Denver with account balances greater than $200, you need to add a WHERE clause. The command becomes SELECT * FROM Customers WHERE (AccountBalance > 200) and (City = "Denver"). Notice the similarity to the QBE command. Of course, with SQL, you need to remember (and type in) the names of the tables and columns. NULL values and BETWEEN commands are also available in SQL.

SQL is also useful when you have complex conditions with several AND and OR connectors. It is easy to enter conditions in the QBE grid, but they can be difficult to read. Remember that you get completely different results if a condition is entered on a different line. But, with many conditions spread across several columns, it can be difficult to see if conditions are on the same line. With SQL, you simply read the text and verify the AND or OR connectors. Figure 4.19 shows the query that lists the customers who live in Denver and owe more than $200. Notice that it is easy to read the AND connector. However, you should always use parentheses to isolate the separate conditions. Also, you have to type in the quotation marks for any text comparisons ("Denver").

One nice feature of Microsoft Access is that you can switch back and forth between SQL and QBE. You can even edit the query in either mode and get the same results. You can use drag-and-drop to create the query, and switch to SQL to verify the AND and OR connectors. To see the effect, use QBE to rebuild the query in Figure 4.16 that lists customers from either Denver or Chicago. Figure 4.20 shows the text when you switch to SQL view. First, note that Access always uses the full

Figure 4.18

Display all columns and rows from the Customers table. You begin to see the power of SQL when you realize you can instantly get all of this data with only three words (and a symbol).

```
SELECT      *
FROM        Customers
```

```
SELECT    Name, Phone, City, AccountBalance
FROM      Customers
WHERE     (AccountBalance>200) AND (City="Denver")
```

Figure 4.19

SQL query to list customers who live in Denver and owe more than $200. It is relatively easy to verify the AND connector. Be sure to use parentheses to separate the conditions.

name of columns, which includes the table name, such as Customers.Name. This approach is reasonable because different tables might use the same column name (such as Salespeople.Name and Customer.Name), and Access needs to keep track of exactly which column you mean. Second, Access uses too many parentheses in the conditions, which makes it hard to edit; but the OR connector is easy to see and you can always return to the QBE grid to change the query conditions.

Different Types of Conditions

It is relatively easy to enter conditions on the criteria rows of the QBE grid or to add them to the SQL WHERE clause. However, to handle more complex cases, you need to understand all of the comparison operators. Some special operators also exist that can save you effort when creating queries. As a manager, you need to be able to convert business questions into database queries. Identifying and specifying conditions is a key step in this process. Once you understand the basic elements of the conditions, the real challenge lies in correctly interpreting the business question.

Figure 4.21 shows the primary comparison operators used in business queries. SQL does support some advanced techniques, such as the IN (list), but you need to understand the basic operators before trying to tackle the complex ideas. The standard comparison operators (=, <, >) work exactly as you expect them to work from basic math. The not-equal operator seems a little tricky (< >), but you get used to it after a while.

The **BETWEEN** operator is a nice way to enter a range of values. It is commonly used for testing a date because you often need to see if a business date falls between two specified days. The condition will match any row where the value is between or equal to the start and end value. For example, to retrieve rows of sales data that occurred in January 2009, you would use: WHERE SaleDate BE-

Figure 4.20

Displaying a query built in Design view. Microsoft Access always uses the full name of the column which includes the table name. It also puts too many parentheses in the conditions. But, the OR connector is easy to read.

```
SELECT Customers.CustomerID, Customers.Name, Customers.Phone,
  Customers.City, Customers.AccountBalance
FROM Customers
WHERE (((Customers.City)="Denver"))
  OR (((Customers.City)="Chicago"));
```

Operator	Meaning	Examples
=	Equals	City='Denver' Salary=60000
< >	Less than Greater than	Salary < 60000 Sales > 15000
< >	Not equal	City < > 'Denver'
BETWEEN	Between x and y	SaleDate BETWEEN '01-Jan-2012' AND '28-Feb-2012' Sales BETWEEN 10000 AND 20000
LIKE	Simple pattern matching % or * matches any characters _ or ? matches one	LastName LIKE 'J%' ProductID LIKE 'BL_ _DR_ _ _'
Null	Missing data	City Is Null
NOT	Negation	Not City = 'Denver'

Figure 4.21

Query conditions. The standard comparisons are easy to understand. BETWEEN is most useful for dates but can be used in other cases. Pattern matching with LIKE is used for simple searches of text data. Be careful to use Is Null when searching for missing data.

TWEEN '01-Jan-2009' AND '31-Jan-2009'. However, note that date values are sometimes tricky to enter into a DBMS. The format used here will work on most systems, but Microsoft Access uses pound signs (#) instead of quotation marks to signify dates: BETWEEN #01-Jan-2009# AND #31-Jan-2009#. Also, when you use the BETWEEN command remember that you must always have two values separate by the AND keyword. Figure 4.22 shows the use of the BETWEEN clause to obtain a list of the sales that took place in June. Figure 4.23 shows the results. Always look through some of the rows of data to verify that you entered the conditions correctly. The DBMS will almost always return results, but you have to inspect them to ensure it is selecting the rows you want to include.

The Is Null and Is Not Null operators are useful but have an important trick. Any value that was not entered is automatically assigned a missing value and can only be found by searching for Is Null. For example, if someone failed to enter the name of the city the customer lives in, you would search: WHERE City Is Null. The important trick is that you cannot use City=Null. Most systems will actually accept the equals sign, but will never return any matching rows—even if the City value is missing. You can stare at that last command a long time trying to figure out what went wrong, until you remember that you must use the IS operator instead of equality. Along the same lines, the condition City="" (quoted text with no value), will also fail. There is a difference between a zero-length string and a value that was never entered. This difference presents problems if someone happens to enter blank spaces for a text value. The DBMS will often display missing values as blank spaces, but they are stored differently internally.

The **LIKE** command is a useful tool but it can be difficult to understand at first. Essentially, you are specifying a search pattern or filter. Only rows that match that condition will be displayed. The LIKE command uses two special charac-

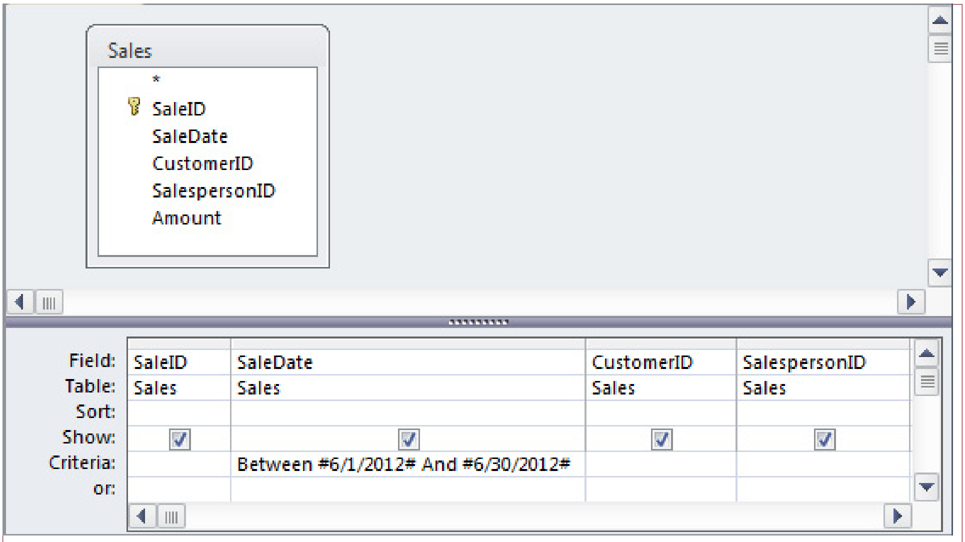


Figure 4.22

The BETWEEN clause. This query uses BETWEEN to retrieve sales that occurred in June.

ters to form patterns. The SQL standard states that a percent sign (%) will match any other characters, including no characters; and an underscore (_) will match any single character. Microsoft Access uses an asterisk (*) and question mark (?) to create the same patterns. You can see the power of pattern matching even for simple business questions. For example, to list the customers with a last name that starts with B, you would use: WHERE LastName LIKE 'B%' (or WHERE Last-Name LIKE "B*" in Access). The B in the pattern requires the name to have that letter in the starting position, followed by any other characters (including none). As another example, the condition WHERE Description LIKE '%smart%' will

Figure 4.23

Date results. Verify that the rows returned match the condition you desire. The DBMS will rarely tell you if you make a mistake. It will almost always return results, so you need to check to ensure you entered the conditions correctly.

	SaleID	SaleDate	CustomerID	Salesperson	Amount
	211	6/9/2012	44453	255	$2,800.00
	213	6/9/2012	44453	255	$12.00
	215	6/9/2012	87535	887	$62.00
	280	6/27/2012	28764	663	$1,036.00
	285	6/15/2012	44453	887	$100.00
*	0	7/6/2011	0	0	$0.00

Record: 1 of 5 No Filter Search

SUM	total value of items
AVG	average of values
MIN	minimum value
MAX	maximum value
COUNT	number of rows
STDEV	standard deviation
VAR	variance of items

Figure 4.24

The standard aggregation functions available in SQL and QBE. These functions operate on multiple rows of data at a time. SUM, AVG, and COUNT are the most-used functions in business.

search for any product that contains the word "smart" anywhere within the description. The word smart must exist, but can be preceded or followed by any other letters. The single-character search is used less often, but can be useful if you have specially-formatted codes. For instance, many companies create product codes that describe the product. Perhaps the first two letters are a color code, followed by a size code, a category, and a three-digit identifier, such as: BL09DR293 to represent a blue (BL) dress (DR) of size 9 (09) with an product identifier of 293. A salesclerk could search the inventory for all blue dresses using the pattern: WHERE ProductID LIKE ''BL_ _DR _ _ _'. You need to know the details of how the product codes are created to build these conditions. In other cases, it is probably easier to search for items by using other columns of data, such as: (ProductType='Dress') AND (Color='Blue').

It is generally easy to create any individual condition. The process becomes more difficult, with more chances for error, when you are given many conditions at the same time. The key is to be patient and write one condition at a time and test the values one at a time. As you will see in the next section, it is important to test the conditions with a simple SELECT statement so you can ensure that the query is retrieving only the rows you need.

Computations

Many business questions involve totals or other calculations. All database systems have some mechanism to perform simple calculations. The calculations are usually simpler than those found in spreadsheets, but they are easier to use and can operate on millions of rows of data.

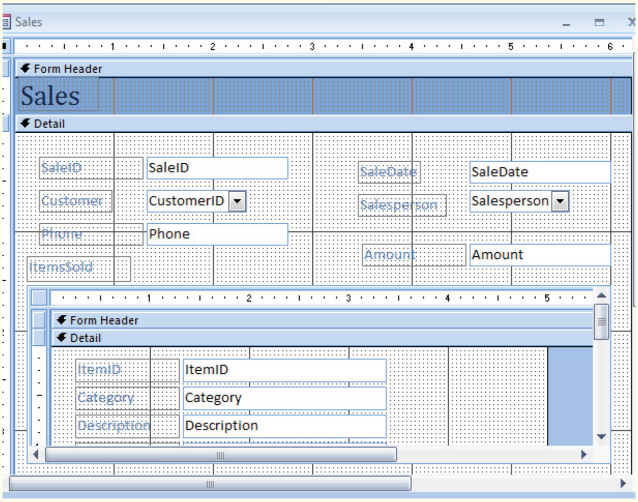
Query processors can perform two types of computations: (1) Compute totals across multiple rows of data, or (2) Use arithmetic and functions to operate on data one row at a time. You can also combine these two methods, but it is best to treat them separately for now. You often need to compute totals or average of business data. Figure 4.24 shows the aggregation functions commonly provided by SQL and QBE. SUM, AVG, and COUNT are the most-used functions in business.

SUM computes the total value of a numeric column. Essentially, it looks at each row of data that matches the WHERE clause and adds up the values stored in each row. Similarly, AVG works only on numeric columns, but it computes the simple average. COUNT is slightly trickier. It simply counts the number of rows of data that would be displayed, so it works with any column or even without a

Technology Toolbox: Building Forms in Access

Problem: Every month you have to create a report that uses several new pieces of data. You have an assistant to help enter data, but need to create a system that is simple to use.

Tools: Most DBMSs have a forms tool to quickly generate forms. In Microsoft Access, the Form Wizard is easy to use, as long as the tables are defined correctly.



It is relatively easy to make forms to enter and edit data for a single row at a time. You can quickly build a form to edit data for a single customer. Start the Form Wizard, select the Customer table and all of its columns by moving them to the right-side column. Work through the remaining selections by choosing design options. If you do not like the result, you can always delete the form and start over. When the form is complete, use it to enter data for a couple of customers.

The Form Wizard can build more complex forms, such as the Sale form that includes data from the tables: Sale, Customer, SaleItem, and Item. You need to be cautious in choosing columns. Start the Form Wizard and choose all columns from the Sale table. Then choose most of the columns from the SaleItem table, but do not include the SaleID. The SaleItem table represents the repeating section. If you include the SaleID, it will waste space by displaying the same value on every row. Next, choose columns from the Customer table, but do not include the CustomerID. You should not include the CustomerID column from the Customer table, because you will not use this form to add new customers. Keep your forms relatively simple, so each form has a clear purpose. Finally, select any desired columns from the Item table (Description, Color, Price, and so on). Once again, do not include the ItemID column from the Item table, because you will not use this form to add items. Once the columns have been selected, follow the prompts to finish building the form.

To make the form easier to use, you will want to switch to Design View and rearrange the items on the form so they are grouped in a layout that is easier to read.

Look at some of the problems with the form. To enter a new sale, you will have to enter the CustomerID. Did you memorize all of the CustomerID values? Instead, delete the CustomerID text box. Select the Combo box in the Toolbox and click on the form where the CustomerID box used to sit. Follow the Wizard prompts to select the Customer table; choose at least the CustomerID and Name columns. On the last screen, make sure you mark the option to store the result in the CustomerID column. Test the result. This procedure displays all of the customers in the drop-down box. When you select a customer, the corresponding CustomerID is transferred to the CustomerID column in the Customer table.

Quick Quiz:

1. Create a simple customer form and enter data to test it.
2. Create a basic order form and add a combo box to select customers.

Amount
$197.54
$526.76
$353.76
$153.00
$863.39
$255.93

Figure 4.25

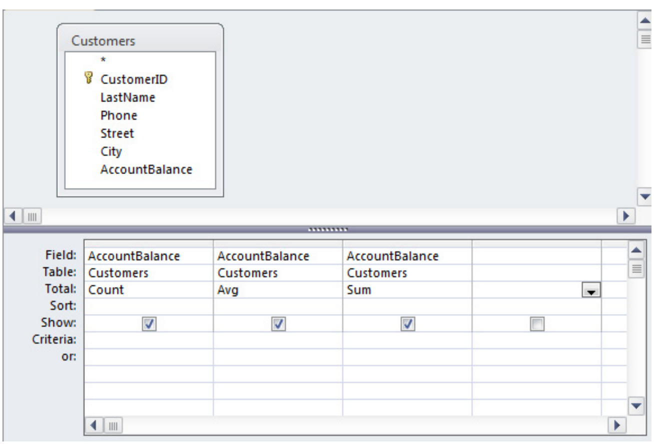
AccountBalance column from the Customer table.

column name: Count(*). Although the functions are similar, you must be cautious when choosing them. It can be difficult to determine when you should use SUM instead of COUNT. Figure 4.25 shows the AccountBalance column for the rows of data in the Customer table. Due to the small amount of data, you can easily verify that there are 6 rows of data.

Figure 4.26 shows the QBE query and the values returned by the COUNT, AVG, and SUM functions. A few seconds with a calculator will convince you that the sum is correct. Always remember that Avg and Sum work only on numeric data because they compute the total of the values stored within each row. You have to carefully evaluate any business question to decide if it requires adding numbers or simply counting rows. The VAR and StDev functions are for simple statistical calculations and compute the variance and standard deviation of the data in the chosen column, using n-1 weighting. The older versions of the SQL query language did not specify standard names for these functions so they are spelled differently depending on the DBMS you are using. The more advanced

Figure 4.26

Count versus Sum. Count returns the number of rows that would be returned with a SELECT statement. Sum adds up the values within each row.



Count	Avg	Sum
6	$391.73	$2,350.38

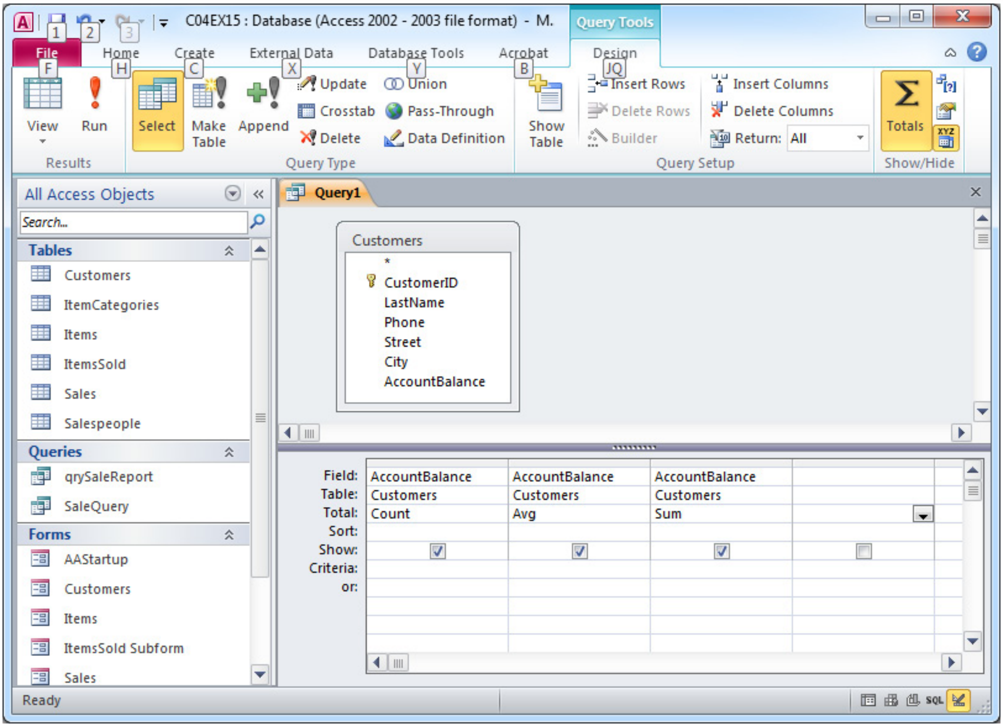


Figure 4.27

QBE for aggregation. In Access, you select the table and columns. Clicking the summation button (sigma) adds the Total row to the grid, where you can pick the Count and Avg functions.

(more expensive) DBMSs support additional aggregation functions, and you can read about them in the vendor's documentation or help system.

Query by Example

Although most database management systems provide a means to compute totals and averages, there is no standard method for entering the commands. Typically, the commands are displayed on a menu. Access uses an extended grid, which is shown in Figure 4.27. The total row is enabled by clicking the summation (sigma) button. You then select the desired function on the Total row using the drop-down list in the appropriate column. The example shows how to get the number of customers and the average account balance.

Computations within a row are a little more complicated because you have to type everything instead of picking from a list. Consider the Items table that lists all of the products for sale. It contains a Category column and a Price column. You are told that all items in the Electronics category have a cost that is 70 percent of the listed price. You want to display the list of items in theElectronics category, their price, and their estimated cost. Figure 4.28 shows the query. Start a new query, choose the Items table, and display the Category and Price columns. Enter the Clothes condition to restrict the rows. Create a new column by typing the formula: 0.7*Price. When you move the cursor to another location, Access will add the brackets and enter Expr1 as the title of the new column. Change Expr1 to EstCost, but be careful to leave the colon separator.

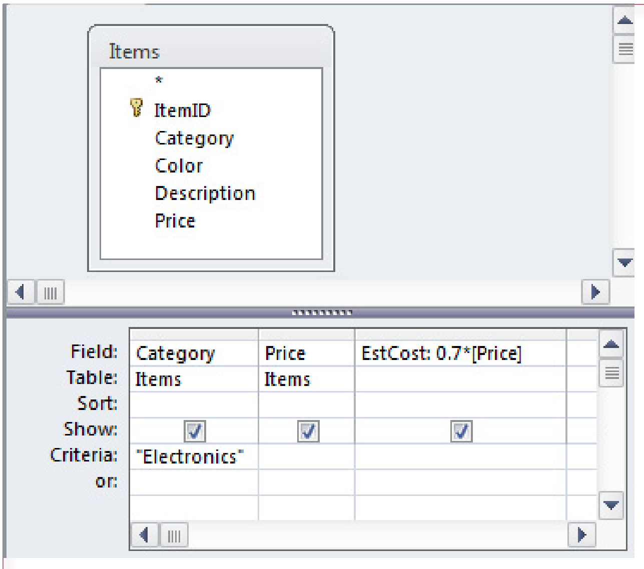


Figure 4.28

Row-by-row calculations. You can use basic arithmetic (+, -, *, /) and common math functions to create a new, computed column in a query. Just type in the formula and then change the text before the colon EstCost) to be displayed as the new column heading.

Figure 4.29 shows the results of running the query. If desired, you can use the Round or Format functions to alter the calculation or the way it is displayed. The main thing to remember is that these computations are performed using only the data on one row. You can use data from multiple columns, but not from different rows.

SQL

Because QBE actually uses SQL, it should be clear that these same queries can be written directly in SQL. In many cases SQL is so easy that it is faster to type the simple SQL commands than it is to work through the QBE grid. Figure 4.30 shows the SQL command to count the number of customers and return the average amount owed. The functions are easy to use, but notice the use of the AS

Figure 4.29

Row-by-row calculations. You can use basic arithmetic (+, -, *, /) and common math functions to create a new, computed column in a query. Just type in the formula and then change the text before the colon EstCost) to be displayed as the new column heading.

Category	Price	EstCost
Electronics	$1,000.00	700
Electronics	$400.00	280

```
SELECT Count(CustomerID) AS NCustomers,
  Avg(AccountBalance) AS AverageOwed
FROM Customers
```

Figure 4.30

Aggregation functions in SQL. The use of the function is straightforward, but note the use of the AS command to create a new name for the output column.

command to provide a new name for the column. If you leave out this name, the system will pick something that is unique but meaningless.

Row-by-row calculations are also straightforward in SQL. In fact, because you have to type the formula even within QBE, it is often easier to type the entire query within SQL. But, if you have complex WHERE clauses (or many tables), you might want to build the base query in QBE and switch to SQL to enter the formula. Figure 4.31 shows the SQL statement to list and estimate the cost of the items in the Electronics category.

Computing Subtotals

One of the most powerful features of SQL is its ability to create subtotals by adding one line to the SELECT statement. Many business questions require the computation of subtotals. In fact, it is difficult to find business questions that do not require subtotals. A subtotal is an aggregate calculation (usually SUM) that you want to perform for all members within a group. Common business examples include: Find the customer with the most sales, or the employee who sold the most last month, or identify the product or category that is the best or worst seller. Subtotals are also used whenever you want to compute totals by time period, such as total costs per month or sales this year compared to last year. Each of these questions requires adding up the value for each element specified (customer, employee, product category, month, year, and so on). It is difficult to compute these subtotals by hand. It is time-consuming even if you write your own program code. First you have to sort the data by the selected attribute to group the values together, then you find the break points where the value switches (such as from James to Jones). SQL (and QBE) solve this problem with one simple line: GROUP BY.

SQL

It is easier to see how subtotals are created by using SQL. Once you understand the process, you can use QBE to define the calculations. The first point to remember is that you want to see subtotals—so you have to use the aggregation functions in the output (SELECT) line. Figure 4.32 shows how to define a basic subtotal

Figure 4.31

Row-by-row computations in SQL. Simply type the formula as a new column and use the AS keyword to give the column a meaningful name.

```
SELECT Category, Price, 0.7*Price AS EstCost
FROM Items
WHERE (Category="Electronics")
```

```
SELECT City, Sum(AccountBalance) AS SumOfAccountBalance
FROM Customers
GROUP BY City
```

Figure 4.32

Subtotals by City. The output line contains a SUM function and the attribute you want to group. Then add the GROUP BY City line to tell the query parser what you want to see.

using SQL. The first two lines are similar to what you have already done. You are asking to see the name of the City and the total of the AccountBalance column. The third line tells the query processor that you want the subtotal computed for each value of city. The nice part is that you do not need to know which cities exist in the database. It automatically sorts and groups the data and then reports the total for each of those cities.

Figure 4.33 shows the total amount due by each city. The query processor automatically sorts the data by the City column because that is how it computes the subtotals. More commonly, you would add an ORDER BY line to sort by the subtotal—so you can find the city where customers owe you the most money.

Take a couple of minutes and study the SQL statement. You will need to use it many times. The query itself is relatively simple—just remember to keep it that way. A common mistake is to add too many columns or extra tables. For GROUP BY queries, you must the smallest number of tables and columns possible. The easiest way to create the query is to think about the output. For any business question, decide what you want to see. In this example, you want a list of cities and the total of the AmountDue for each city, so the SELECT statement contains only the City and Sum(AmountDue). Both columns are in the Customers table, so you list that on the FROM statement. The phrases "for each" or "group" in any business questions are clues that you need to add the GROUP BY line.

An important catch with basic SQL is that any query using GROUP BY can display only subtotals (or other aggregate functions). It cannot display the detail rows and then the subtotals. If you want both details and totals, you must write a second query. A newer version of the SQL standard does have the ability to display both detail rows and subtotals, but it is relatively complex and it is not supported by Microsoft Access. More importantly, if you truly want to see that much information, better tools exist to examine the data interactively, and these are covered in Chapter 9.

Figure 4.33

Subtotals by City. Each city is listed followed by the total amount owed by customers in that city. It is important that you include only these columns and nothing extra.

City	SumOfAccountBalance
Chicago	$197.54
Denver	$1,016.39
Miami	$255.93
Phoenix	$526.76
Seattle	$353.76

Customers

CID	LastName	Phone	City	AccountBalance
12345	Jones	312-555-1234	Chicago	$197.54
28764	Adamz	602-999-2539	Phoenix	$526.76
29587	Smitz	206-656-7763	Seattle	$353.76
33352	Sanchez	303-444-1352	Denver	$153.00
44453	Kolke	303-888-8876	Denver	$863.39
87535	James	305-777-2235	Miami	$255.98

Salespeople

SPID	LastName	DateHired	Phone	Commission
255	West	5/23/75	213-333-2345	5
452	Thomas	8/15/94	213-343-5553	3
554	Jabbar	7/15/91	213-534-8876	4
663	Bird	9/12/93	213-225-3335	4
887	Johnson	2/2/92	213-887-6635	4

Items

ItemID	Category	Color	Description	Price
1154	Shoes	Red	Red Boots	$100.00
2254	Clothes	Blue	Blue Jeans	$12.00
3342	Electronics	Black	LCD-40 inch	$1,000.00
7653	Shoes	Blue	Blue Suede	$50.00
8763	Clothes	Black	Mens' Work Boots	$45.00
9987	Electronics	Silver	Blu-Ray Player	$400.00

Sales

SaleID	CID	SPID	SaleDate	Amount
117	12345	887	3/3/2012	$1400.00
125	87535	663	4/4/2012	$535.00
157	12345	554	4/9/2012	$100.00
169	29587	255	5/5/2012	$1800.00
178	44453	663	5/1/2012	$12.00
188	29587	554	5/8/2012	$1180.00
201	12345	887	5/28/2012	$100.00
211	44453	255	6/9/2012	$2800.00
213	44453	255	6/9/2012	$12.00
215	87535	887	6/9/2012	$62.00
280	28764	663	5/27/2012	$1036.00
285	44453	887	6/15/2012	$100.00

ItemsSold

SaleID	ItemID	Quantity
117	1154	2
117	3342	1
117	7653	4
125	1154	4
125	8763	3
157	7653	2
169	3342	1
169	9987	5
178	2254	1

Figure 4.34

Multiple tables. The true power of a database lies in the ability to combine data from multiple tables. Actual databases can have hundreds or thousands of related tables. Notice that each table is related to another table through matching columns. You should be able to draw lines between column labels that will connect each of the tables.

Joining Multiple Tables

The true strength of a database management system lies in its ability to combine data from several tables. Part of the Customer table is shown in Figure 4.34, with additional tables that show a list of sales to those customers and the salespeople involved. Notice that the tables were designed so they can be connected. For example, the Sales table can be connected to the Customers table by matching the CustomerID (abbreviated as CID to save space). The Sales table can be matched to the Salespeople table through the SalespersonID (SPID). Once you have joined the tables together, the database system retrieves and displays the data as if it were stored in one table.

The chief advantage to using multiple tables is that data is stored one time—even for one-to-many relationships. For example, each salesperson may be associated with many different sales. Instead of repeating the salesperson information on every order, you only need to include the salesperson's ID (SPID) number. Joining the tables together tells the DBMS to automatically look up the corresponding data from the Salespeople table.

Query by Example

Most people find that database systems that use graphical QBE commands to join tables together are much easier to use than straight SQL commands. With a DBMS like Access you join the tables together by pointing to the column name in one table and dragging it to the matching column in the other table. The DBMS displays the connection between the two columns. Whenever you want to retrieve data from more than one table, you must first join them together.

SQL

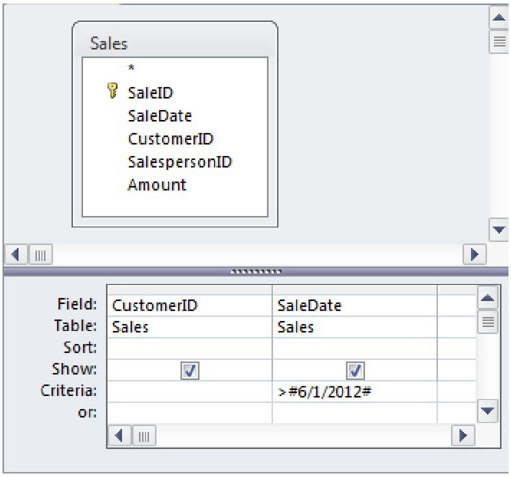
In SQL, connections between tables are typically made with the INNER JOIN clause in the FROM statement. For example, to join the Customers and Orders tables by equal customer numbers and get the combined data, use the command SELECT * FROM Customers INNER JOIN Orders ON Customers.CustomerID = Orders.CustomerID

Notice that both tables must be listed in the FROM statement. Always remember that if you list more than one table, the tables must be joined. The dot before the column (CustomerID) separates the table name from the column name (table.column). You can use this form any time you type in a column name, but it is only required when there might be confusion about which table the column is in. In the example, both tables have a column called CustomerID. To keep them straight, you have to specify which table you want to use.

Examples

You now have the basics to begin asking questions of the data. Start with an easy one. Which customers (CustomerID) have placed orders since June 1, 2012? The query and result are shown in Figure 4.35. Notice that customer number 44453 has placed two orders. Some systems will show you the order number twice; others will automatically delete the duplicates.

It can be difficult to remember each customer's number, so it is better to use the customer name and have the DBMS automatically look up the customer number. This second query is shown in Figure 4.36. Note that the Customer table is joined to the Orders table by the matching values of CustomerID. Be cautious when adding tables to a query and make sure that all of the tables are connected. If you




```
SELECT    CustomerID, SaleDate
FROM      Sales
WHERE     SaleDate >= #6/1/2012#
```

CustomerID	SaleDate
44453	6/9/2012
44453	6/9/2012
87535	6/9/2012
28764	6/27/2012

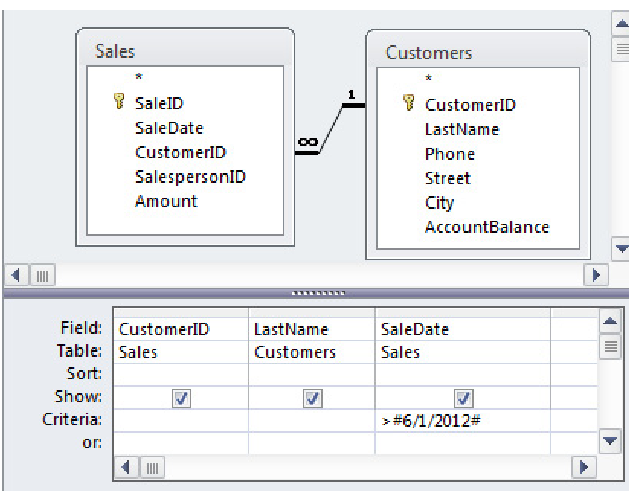
Figure 4.35

QBE and SQL. Which customers have placed orders since June 1, 2006? QBE and SQL are based on the same fundamental concepts. You build each query by asking the same four basic questions.

place two tables in the query with no connection, the query will still run—very slowly. The query processor will match every row in the first table with every row in the second table. For example, if each table has 1,000 rows, the resulting query would contain 1 million rows—and the results would be meaningless.

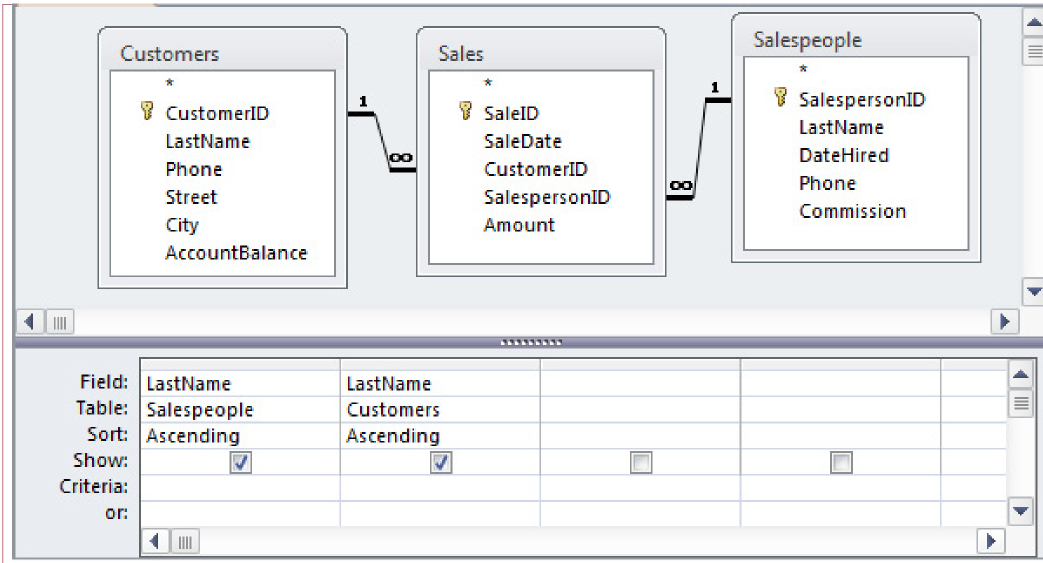
Figure 4.36

Multitable queries. Queries that use more than one table are slightly more complex. Because columns can have any name, you must tell the database system how the tables are connected. What are the names of the customers who placed orders since June 1?




```
SELECT    DISTINCT CustomerID,
  Name, SaleDate
FROM      Sales
INNER JOIN Customers
    ON Sales.CustomerID
  = Customers.CustomerID
WHERE     SaleDate >= #6/1/2012#
```

CID	Name	OrderDate
28764	Adamz	6/27/2012
44453	Kolke	6/9/2012
44453	Kolke	6/15/2012
87535	James	6/9/2012




```
SELECT      DISTINCT Salespeople.LastNameName,
              Customers.LastName
FROM        Salespeople
INNER JOIN      (Customers INNER JOIN Orders ON
            Customers.CustomerID=Sales.CustomerID)
            ON Salespeople.SalespersonID
              = Sales.SalespersonID
ORDER BY        Salespeople.LastName
```

SalesName	Cust.Name
Bird	Adamz
Bird	James
Bird	Kolke
Jabbar	Jones
Jabbar	Smitz
Johnson	James
Johnson	Jones
Johnson	Kilke
West	Kolke
West	Smitz

Figure 4.37

Multitable queries with several joins. More complicated queries follow the same basic rules. Note that some database management systems can automatically switch displays between QBE and SQL. This feature is useful so that you can check the joins and the criteria to be sure they are being interpreted correctly. salespeople (sorted alphabetically) along with the names of customers who placed orders with that salesperson.

Now, try a more complicated query: List the salespeople (sorted alphabetically) with the names of the customers who placed orders with that salesperson. This question sounds difficult, but the command is easy when you join all three tables together. The query and the result are shown in Figure 4.37. Notice there is no entry for the salesperson (Zeke) who has no sales at this point.

Multiple Tables, GROUP BY, and WHERE

The basic concept of multiple tables is straightforward—once you have chosen the tables and joined them correctly, you can select columns from any of the tables. However, be cautious about using extra tables. Each query should use the minimum number of tables needed to answer the question. Extra tables can create problems and incorrect answers—particularly when computing totals.

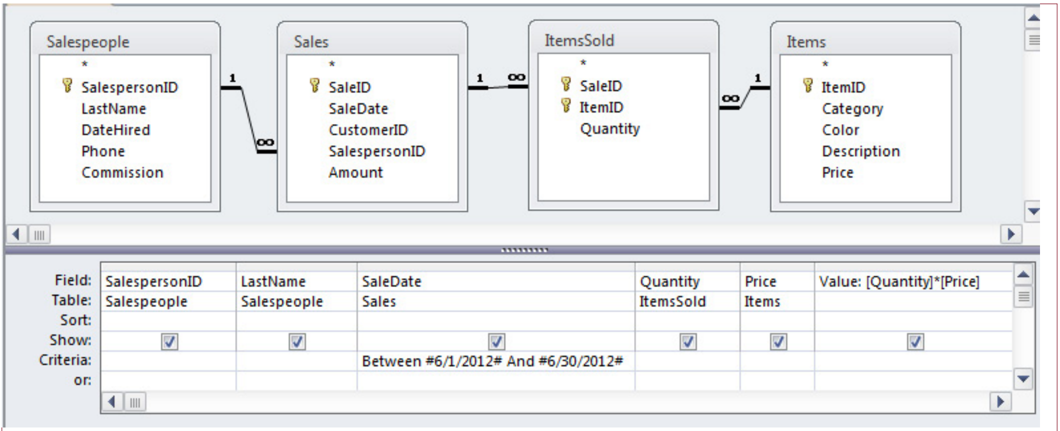


Figure 4.38

Subtotals with a WHERE condition. The WHERE condition is applied first and limits the rows used to compute the totals.

With the ability to use multiple tables, it is now time to look at more realistic questions. Consider the business question: Who are the top salespeople in June? The key to understanding this question is to recognize that the answer requires computing the total sales by employee in the month of June. Begin by creating a query that lists the sales in June along with the name of the salesperson.

As shown in Figure 4.38, you can add a WHERE condition to control the rows that will be used in the computations. The other important step is to create the Value column which multiplies price by quantity. Notice that this query requires four tables: One for the name of the salesperson, two for the Sales data, and one for the price of the items.

Figure 4.39 shows the rows from the initial query. Each row displays the sale of one item, although there can be multiple quantities of that item. Notice that Price and Quantity are displayed so you can verify that the Value column is computed correctly. When building queries, it is important to display intermediate results to

Figure 4.39

Initial query results to compute the value column. Each row represents the sale of one item. Price and quantity are temporarily displayed to verify the Value computation.

SalespersonID	Name	SaleDate	Quantity	Price	Value
255	West	6/9/2012	2	$1,000.00	$2,000.00
255	West	6/9/2012	5	$50.00	$250.00
255	West	6/9/2012	1	$12.00	$12.00
887	Johnson	6/9/2012	1	$12.00	$12.00
887	Johnson	6/9/2012	1	$50.00	$50.00

```
SELECT Salespeople.SalespersonID, Salespeople.Name,
  Sum([Quantity]*[Price]) AS [Value]
FROM Items INNER JOIN ((Salespeople
INNER JOIN Sales
  ON Salespeople.SalespersonID = Sales.SalespersonID)
INNER JOIN ItemsSold
  ON Sales.SalesID = ItemsSold.SaleID)
  ON Items.ItemID = ItemsSold.ItemID
WHERE (Sales.SaleDate Between #6/1/2012# And #6/30/2012#)
GROUP BY Salespeople.SalespersonID, Salespeople.Name
ORDER BY Sum([Quantity]*[Price]) DESC;
```

Figure 4.40

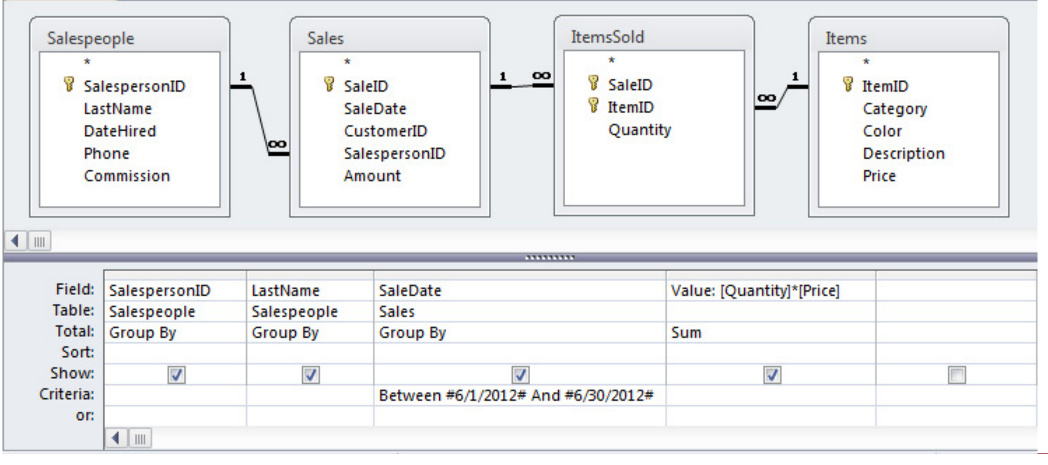
SQL query to compute subtotals with WHERE condition. Notice that the date condition is specified in a WHERE clause because that filters the rows that will be used in the computation.

ensure that computations are specified correctly. Because a WHERE condition is also used, the SaleDate values should also be checked to ensure the correct data is being displayed. If you make a mistake when specifying a WHERE condition, the only way to catch it is to look at the rows that are returned.

The next step is to remove the Quantity and Price columns and then compute the total of the Value column. Figure 4.40 shows the SQL statement that answers the question about total sales by salesperson in June. Note the Sum function in the SELECT clause which specifies the total computation. More importantly, observe that the WHERE clause holds the date condition (June). This condition filters the rows that will be used in the computations. Finally, the GROUP BY clause speci-

Figure 4.41

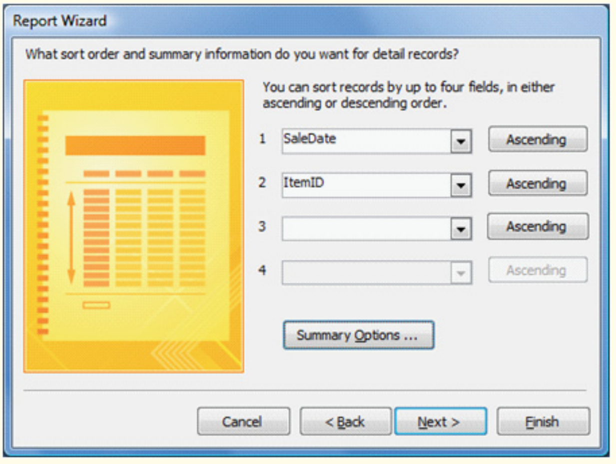
Initial attempt to compute subtotals. Click the Totals button and set the Sum option for the Value column. Notice that the other columns are automatically set to GROUP BY.



Technology Toolbox: Creating Database Reports

Problem: Your company has a large database that contains the information you need. However, you need to produce a relatively complex report every month based on data in that database.

Tools: A database Report Wizard can help you build reports with a visually oriented tool that makes it easy to create the layout and subtotals that you want.



If you need in-line computations, such as price * quantity, it is generally easiest to create a query that performs these simple calculations and selects the columns you will need on the report. Just create a query, test the data, and save it as a view. Then open the Report Wizard and select the saved view. Otherwise, you can select individual tables and choose the columns you want from each table.

The key to understanding reports is to use the groupings and levels correctly. First, identify the data that you want to see at the most detailed level. For example, you might want to see individual sale items. In creating the underlying query, make sure you select the tables and columns necessary to display the detail level you need. Sometimes, you will want to use subtotals in the query, but many times you will simply let the report writer create the totals—it all depends on what you want to see at the detail level. The next decision is to identify what groupings and levels you need. For instance, you might want to see a list of items ordered by each customer, so you set a grouping by customer. Alternatively, you might want to see a list of orders by each customer, so you set groupings for customer and then for order.

The Form Wizard contains an option to compute totals for the numeric columns. The button to select this option is easy to miss, so look carefully. Once the Wizard creates the design, you will still have to set properties to improve the format and layout of the report. You can also add new text boxes to compute other values. For example, to create a total, just place a text box in the desired footer and enter the formula =Sum(Value), using whatever column you want to total.

Creating reports is detail work. It takes time to get the layout and the format right. It takes a sense of design to make the report look good. Remember that the goal is to present the important information so that it can be found quickly.

Quick Quiz:

1. Create a report that prints all of the items ordered by each customer.
2. Create a report that prints each customer, followed by the orders for that customer.
3. Create a report that displays a chart of total sales by customer.

SalespersonID	Name	SaleDate	Value
255	West	6/9/2012	$2,250.00
255	West	6/10/2012	$12.00
887	Johnson	6/9/2012	$62.00

Figure 4.42

Unfinished query. GROUP BY with SaleDate results in two rows for Salesperson 255—one for each day.

fies that the totals are to be computed for each sales person. The ID and the name are both included because there is a chance that two employees have the same name. Including the ID ensures that employees with the same name will be treated separately.

Look at the SQL statement again and be sure that you understand the main points; then you can use the Access design grid to finish the query. Figure 4.41 shows the initial attempt. Remove the Quantity and Price columns. Use the totals button to add the Total row and select the Sum option for the Value column. Leave the other columns at the default GROUP BY option.

Figure 4.42 shows what happens when this initial query is executed. Look at the ID and Name columns. The question calls for computing totals for each salesperson, so the query should have only one row for each person. These results contain two rows for ID 255 (West). Why? Look back at the query grid, or better yet, look at the SQL statement. The query lists three columns as GROUP BY: ID, Name, and SaleDate. So the DBMS computed exactly what you asked for: The total value for each salesperson for each day. The second row for West arose because the sale took place on a second day. If the database contained a complete set of monthly data, the query would return different totals for every day in the month for each employee.

The solution to the problem is to remove the SaleDate from the GROUP BY condition. In the Access grid, this task is accomplished by changing the GROUP BY entry on the Total row to WHERE. Figure 4.43 shows the final query in the grid. Set the SaleDate row to Where and sort the Value in descending order to display the highest value at the top of the list. When you change the SaleDate to the WHERE entry, notice that the display checkbox is unset. Do not attempt to restore the check mark—that would tell the query to display both the individual detail rows and the totals. But Access, and the standard GROUP BY SQL query, cannot display details and totals at the same time. Run the query now and you will see that it returns exactly one row for each employee who participated in a sale in June. Remember this lesson. When computing subtotals that involve date conditions, you almost always want to move the date condition to the WHERE clause. The only exception is when you actually want to compute sales by day.

Views

There is one important feature of queries that you will find useful. Any query can be saved as a **view**. For example, if you have a complex query that you have to run

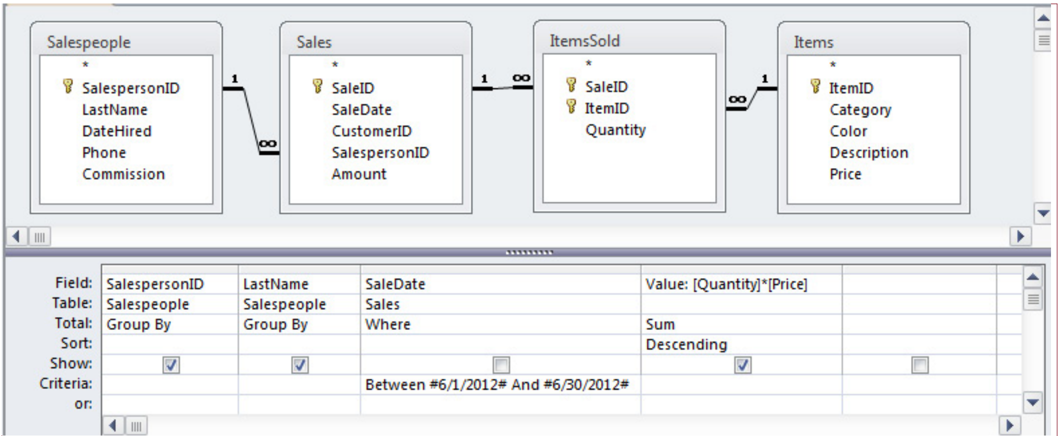


Figure 4.43

Correct version of the query grid. The WHERE identifier under the SaleDate column removes the SaleDate from the GROUP BY clause and places it in the WHERE clause.

every week, you (or a database specialist) could create the query and save it as a view with its own name. The important point is that the view can now be treated like any other table. In the example, you might define a view that combines the tables for customers, orders, and salespeople, and call it SalesOrders. Then, to get the total sales from customers in Miami, you run the query on the SalesOrders view and you no longer have to worry about joining tables because the query has already performed the step.

The advantage of views is that you can look at the data in different ways without having to duplicate the data. As a manager, you can create complex views so your employees can look up information using much simpler commands. Think of a view as a mirror. If you stand in front of a three-way mirror in a clothing store, you get different views of yourself although there is still only one person.

Converting Business Questions to Queries

The query grid and SQL are relatively easy to use. The real challenge lies in understanding the business question and correctly converting it into a query. In fact, this task demonstrates the true role of MIS. One of the most difficult tasks in applying information technology and creating systems is to identify the business needs and translate them into the computer realm. Students who become good at this translation, can solve problems quicker and become more successful.

The key to translating business questions into queries is to focus on the four questions posed at the start of this section: (1) What do you want to see? (2) What constraints are you given? (3) What tables are involved? And (4) How are the tables joined? And, it is usually easiest if you answer the questions in that order. In business, the second key is to understand exactly what data is stored in the database tables. Ultimately, you need to know what all of the tables mean and exactly what type of data is stored in each column. The good news is that once you have worked for a company for a couple of years, the terms and data will become

```
SELECT      _______________
FROM        _______________
INNER JOIN  _______________
WHERE       _______________
GROUP BY    _______________
ORDER BY    _______________
```

Figure 4.44

Primary SQL clauses. Write these down and fill in the blanks to start a new query. You can simplify the FROM and INNER JOIN parts by just listing the tables and drawing connector lines.

familiar to you. The bad news is that company databases can hold hundreds of tables and thousands of columns.

For longer queries, you should write down the basic SQL clauses as shown in Figure 4.44. As you read the business question, you fill in the blanks. Of course, you will need the relationship diagram or a list of tables in the database so you know the names of the tables and columns. Consider an example from the Rolling Thunder Bicycle company database. The business question: Which customers from California spent the most money on race bikes in 2010? The relationship diagram is shown in the Exercises at the end of this chapter, or you can open the database and examine the diagram or the tables directly.

The first step is to decide what you want to see. The business question calls for information about customers, so you should include at least the customer last name and perhaps their phone numbers. You have some flexibility to add other data but keep it simple at the beginning. You also want to see the total amount of money spent by each customer. The best way to represent that value is to look at the SalePrice of each bicycle that was purchased. This number ignores taxes and shipping costs which are not revenue to the firm, but managers might want these additional values in some cases. You can now write the SELECT clause:

SELECT LastName, Phone, Sum(SalePrice) As TotalSales

Now look at the constraints you are given. Reread the business question and you should see three constraints: California, 2010, and race bikes. Each of these becomes a condition in the WHERE clause. Since all three conditions must be met at the same time, they are all connected with AND clauses. Look through the list of columns in the Bicycle table and you can find the appropriate columns to use (SaleState, OrderDate, and ModelType). If you are unsure about the data held in each column, you can display a few rows of data from the table to check the values. You can now write the WHERE clause.

```
WHERE (SaleState=”CA”)
AND (OrderDate BETWEEN #1/1/2010# AND #12/32/2010#)
AND (ModelType=”Race”)
```

Because you need to compute the total value for each customer, you must add a GROUP BY clause. This clause must list each column in the SELECT clause that is not part of an aggregation function.

```
GROUP BY LastName, Phone
```

Now that you know all of the columns needed, you can see which tables were used. In this case, the Bicycle and Customer tables, so you can write the FROM clause.

```
FROM Bicycle, Customer
```

To avoid memorizing the INNER JOIN syntax, you will eventually use the query grid tool to enter the tables and build the joins graphically. But, you should still verify that the tables will be connected. On the INNER JOIN clause, draw lines between the tables to indicate how they are connected.

INNER JOIN Bicycle.CustomerID = Customer.CustomerID

In some cases, you will initially list tables that are not directly connected. For instance, you might use the Bicycle table and the Components table in a query. But, remember that every table must be connected when you build a query. In these situations, go back to the relationship diagram and look for an intermediary table that connects the ones you need. In this example, the BikeParts table connects to both the Bicycle and Component table, so you must add it to your FROM clause.

Finally, you can sort the data to organize it to answer the question. In this case, you want to know which customers spent the most money, so sort the results in descending order of the total.

```
ORDER BY Sum(SalePrice) DESC
```

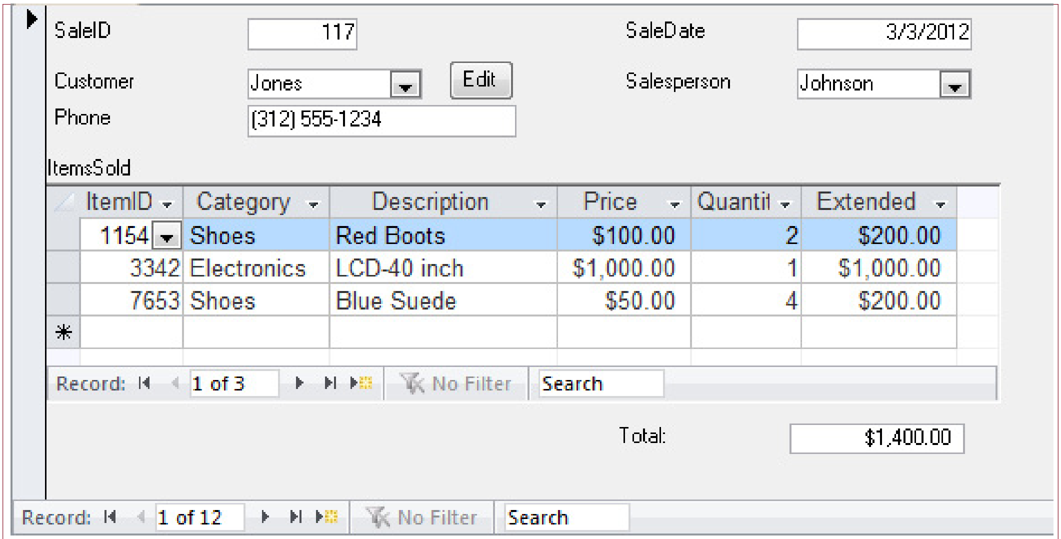
Notice that this query will give you multiple rows. The best customers will be listed at the top, but does that really answer the question? Technically, you could cut off the list to display just the values at the top (SELECT TOP 5 LastName, Phone, …). However, as a businessperson, you probably want to see more than just the first row. You generally want to know if there are ties, how close the second-place person is to the first, and so on. So, in reality, when a businessperson asks for the "best" or "worst" he or she generally means to sort the list and show at least the first few top items in the list.

The other big hint in building queries is that sometimes they get very complex and it is difficult to determine how to approach the problem. In these situations, always start with the parts you know how to do. For example, you generally know how to enter conditions, so write those down. Then figure out roughly what you want to see for output and write those columns down on the SELECT line. Build the query in pieces and test it to ensure that you are obtaining exactly the rows you need. If necessary, work with one table at a time and add them one at a time, verifying each step by running the query. If you need computations, verify that you know how to do them, and add them to the SELECT line. Hold off on the totals until the end because you cannot tell if the totals are correct when looking at just one number.

Designing a Database (optional)

How do you create a new database? Database management systems are powerful tools with the ability to present data in many ways. They are used by managers to answer many different types of questions. However, this flexibility is not automatic. Databases need to be carefully designed; otherwise, managers will not be able to get the information they need. Poor design also leads to unnecessary duplication of data. Duplication wastes space and requires workers to enter the same data several times. **Normalization** is an important technique to design databases.

To understand the process of normalization, consider the example of retail sales. You begin by thinking about who will be using the database and identifying what data they will need. Consider the situation of the salespeople. They first identify the customer then record each item being purchased. The computer



SaleID 117 SaleDate 3/3/2012

Customer Jones Edit Salesperson Johnson

Phone (312) 555-1234

ItemsSold

ItemID	Category	Description	Price	Quantity	Extended
1154	Shoes	Red Boots	$100.00	2	$200.00
3342	Electronics	LCD-40 inch	$1,000.00	1	$1,000.00
7653	Shoes	Blue Suede	$50.00	4	$200.00
*					

Record: 1 of 3 No Filter Search

Total: $1,400.00

Record: 1 of 12 No Filter Search

Figure 4.45

The order form is used in almost any firm. We need to determine the best way to store the data that is collected by this form.

should then calculate the amount of money due along with any taxes. Figure 4.45 shows a sample input screen that might be used.

The key design point is that you will need multiple tables to store the data. If you try to cram all of it into a single table, you will end up with unnecessary duplication of data and plenty of problems when you try to delete or insert new data. Each entity or object on the form will be represented by a separate table. For this example, there are five objects on the form: Customers, Salespeople, Items, Sale, and ItemsSold..

Before explaining how to derive the five tables from the form, you need to understand some basic concepts. First, remember that every table must have a primary key. A primary key is one or more columns that uniquely identify each row. For example, you anticipate problems with identifying customers, so each customer will be assigned a unique ID number. Similarly, each item is given a unique ID number. There is one drawback to assigning numbers to customers: you cannot expect customers to remember their number, so you will need a method to look it up. One possibility is to give everyone an ID card imprinted with the number—perhaps printed with a bar code that can be scanned. However, you still need a method to deal with customers who forget their cards. It is usually better to build a method to lookup customers by name.

The second aspect to understand when designing databases is the relationships between various entities. First, observe that there are two sections to the form: (1) the main sale that identifies the transaction, the customer, the salesperson, and the date, and (2) a repeating section that lists the items being purchased. Each customer can buy several different items at one time. There is a **one-to-many** relationship between the Sale and the ItemsSold sections. As you will see, identifying one-to-many relationships is crucial to proper database design.

In some respects, designing databases is straightforward: There are only three basic rules. However, database design is often interrelated with systems analysis.

Reality Bytes: Internationalization: ZIP Codes

Databases often contain addresses (of customers, suppliers, employees, etc.), that typically use zip codes. In the United States, zip codes typically consist of five digits, so it is tempting to set up a ZipCode column that restricts input to five integers. However, bulk mail is often cheaper if it uses nine-digit zip codes (zip + 4).

Even more important, if your addresses might someday include international data, you have to be more careful in column restrictions. For instance, Canadian and British postal codes include alphabetic characters in the middle of the code. Some areas (such as Hong Kong) do not use any postal codes.

Similarly, when you set up databases that include phone numbers, be sure to allocate enough space for area codes. If international phone numbers will be listed, you need to add three extra digits on the front for the international country code.

In most cases, you are attempting to understand the business at the same time the database is being designed. One common problem that arises is that it is not always easy to see which relationships are one-to-many and which are one-to-one or many-to-many.

Notation

It would be cumbersome to draw pictures of every table that you use, so you usually write table definitions in a standard notation. The base customer table is shown in Figure 4.46, both in notational form and with sample data.

Figure 4.46 illustrates another feature of the notation. You denote one-to-many or repeating relationships by placing parentheses around them. Figure 4.47 represents all the data shown in the input screen from Figure 4.45. The description is created by starting at the top of the form and writing down each element that you encounter. If a section contains repeating data, place parentheses around it. Preliminary keys are identified at this step by underlining them. However, you might have to add or change them at later steps. You can already see some problems with trying to store data in this format. Notice that the same customer name, phone, and address would have to be entered several times.

Remember that some repeating sections are difficult to spot and might consist of only one column. For example, how many phone numbers can a customer have? Should the Phone column be repeating? In the case of the retail store, probably not, because you most likely want to keep only one number per customer. In other businesses, you might want to keep several phone numbers for each client. Data normalization is directly related to the business processes. The tables you design depend on the way the business is organized.

First Normal Form

Now that you have a way of writing down the assumptions, it is relatively straightforward to separate the data into tables. The first step is to split out all repeating sections. Think about the problems that might arise if you try to store the repeating data within individual cells. You will have to decide how many rows to set aside for storage, and you will have to write a separate search routine to evaluate data within each cell, and complications will arise when inserting and deleting data. Figure 4.48 illustrates the problem.

Table name

Table columns

Customer(CustomerID, LastName, Phone, Street, City, AccountBalance)

CID	Last Name	Phone	Street	City	Balance
12345	Jones	(312) 555-1234	125 Elm Street	Chicago	$197.54
28764	Adamz	(602) 999-2539	938 Main Street	Phoenix	$526.76
29587	Smitz	(206) 676-7763	523 Oak Street	Seattle	$353.76
33352	Sanchez	(303) 444-1352	999 Pine Street	Denver	$153.00
44453	Kolke	(303) 888-8876	909 West Avenue	Denver	$863.39
87535	James	(305) 777-2235	374 Main Street	Miami	$255.93

Figure 4.46

Notation for tables. Table definitions can often be written in one or two lines. Each table has a name and a list of columns. The column (or columns) that makes up the primary key is underlined.

The answer to this problem is to pull out the repeating section and form a new table. Then, each item purchased by a customer will fill a new row. Figure 4.48 uses the notation to show how the table will split. Notice that whenever you split

Figure 4.47

Converting to notation. The basic rental form can be written in notational form. Notice that repeating sections are indicated by the inner parentheses. If we actually try to store the data this way, notice the problem created by the repeating section: Each time a customer checks out a video we have to reenter the phone and address.

SaleForm(SaleID, SaleDate, CustomerID, Phone, Name, Street, (ItemID, Quantity, Description, Price))

Repeating Section

Causes duplication

SaleID	SaleDate	CID	Name	Phone	Street	ItemID	Qty	Description	Price
117	3/3/2012	12345	Jones	(312) 555-1234	125 Elm Street	1154	2	Red Boots	$100.00
117	3/3/2012	12345	Jones	(312) 555-1234	125 Elm Street	3342	1	LCD-40 inch	$1,000.00
117	3/3/2012	12345	Jones	(312) 555-1234	125 Elm Street	7653	4	Blue Suede	$50.00
125	4/4/2012	87535	James	(305) 777-2235	374 Main Street	1154	4	Red Boots	$100.00
125	4/4/2012	87535	James	(305) 777-2235	374 Main Street	8763	3	Men's Work Boots	$45.00
157	4/9/2012	12345	Jones	(312) 555-1234	125 Elm Street	7653	2	Blue Suede	$50.00
169	5/6/2012	29587	Smitz	(206) 676-7763	523 Oak Street	3342	1	LCD-40 inch	$1,000.00
169	5/6/2012	29587	Smitz	(206) 676-7763	523 Oak Street	9987	2	Blu-Ray Player	$400.00
178	5/1/2012	44453	Kolke	(303) 888-8876	909 West Avenue	2254	1	Blue Jeans	$12.00
188	5/8/2012	29587	Smitz	(206) 676-7763	523 Oak Street	3342	1	LCD-40 inch	$1,000.00
188	5/8/2012	29587	Smitz	(206) 676-7763	523 Oak Street	8763	4	Men's Work Boots	$45.00
201	5/23/2012	12345	Jones	(312) 555-1234	125 Elm Street	1154	1	Red Boots	$100.00

SaleID	SaleDate	CID	Name	Phone	Street	ItemID, Quantity, Description, Price
117	3/3/2012	12345	Jones	312-555-1234	125 Elm Street	1154, 2, Red Boots, $100.00 3342, 1, LCD-40 inch, $1,000.00 7653, 4, Blue Suede, $50.00
125	4/4/2012	87535	James	305-777-2235	374 Main Street	1154, 4, Red Boots, $100.00 8763, 3, Men's Work Boots, $45.00
157	4/9/2012	12345	Jones	312-555-1235	125 Elm Street	7653, 2, Blue Suede, $50.00
169	5/6/2012	29587	Smitz	206-676-7763	523 Oak Street	3342, 1, LCD-40 inch, $1,000.00 9987, 2, Blu-Ray Player, $400.00
178	5/1/2012	44453	Kolke	303-888-8876	909 West Ave.	2254, 1, Blue Jeans, $12.00
188	5/8/2012	29587	Smitz	206-676-7763	523 Oak Street	3342, 1, LCD-40 inch, $1,000.00 8763, 1, Men's Work Boots, $45.00
201	5/23/2012	12345	Jones	312-555-1234	125 Elm Street	1154, 1, Red Boots, $100.00

Figure 4.48

A table that contains repeating sections is not in first normal form. Each table cell can contain only basic data. Storing it in repeating form makes it difficult to search, insert, and delete data. This version is not in first normal form.

a table this way, you have to bring along the key from the prior section. Hence, the new table will include the SaleID key as well as the ItemID key. When a table contains no repeating sections, you say that it is in first normal form.

Second Normal Form

Even if a table is in first normal form, there can be additional problems. Consider the SaleLine table in Figure 4.49. Notice the two components to the key: SaleID and ItemID. The nonkey items consist of the Quantity, Description, and Price of the item. If you leave the table in this form, consider the situation of selling a new item. Every time an item is sold it will be necessary to reenter the Description and list Price. It means that you will be storing the description every time an item is sold. Popular items might be sold thousands of times. Do you really want to store the description (and other data) each time?

The reason you have this problem is that when the SaleID changes, the item description stays the same. The description depends only on the ItemID. If the Price represents the list price of the item, the same dependency holds. However, what if the store offers discounts on certain days or to specific customers? If the price can vary with each transaction, the price would have to be stored with the SaleID. The final choice depends on the business rules and assumptions. Most companies resolve the problem by creating a list price that is stored with the item and a sale price that is stored with the transaction. However, to simplify the problem, stick with just the list price for now.

When the nonkey items depend on only part of the key, you need to split them into their own table. Figure 4.50 shows the new tables. When each nonkey column in a table depends on the entire key, the table is in second normal form.

Third Normal Form

Examine the SaleForm2 table in Figure 4.49. Notice that because the primary key consists of only one column (SaleID), the table must already be in second normal form. However, a different problem arises here. Again, consider what happens when you begin to collect data. Each time a customer comes to the store and buys something there will be a new transaction. In each case, you would have to record

SaleForm(SaleID, SaleDate, CID, Phone, Name, Street, (ItemID, Quantity, Description, Price))

SaleForm2(SaleID, SaleDate, CustomerID, Phone, Name, Street)

Note replication

SaleID	SaleDate	CID	Name	Phone	Street
117	3/3/2012	12345	Jones	(312) 555-1234	125 Elm Street
117	3/3/2012	12345	Jones	(312) 555-1234	125 Elm Street
117	3/3/2012	12345	Jones	(312) 555-1234	125 Elm Street
125	4/4/2012	87535	James	(305) 777-2235	374 Main Street
125	4/4/2012	87535	James	(305) 777-2235	374 Main Street

SaleLine(SaleID, ItemID, Quantity, Description, Price)

Note replication

SaleID	ItemID	Quantity	Description	Price
117	1154	2	Red Boots	$100.00
117	3342	1	LCD-40 inch	$1,000.00
117	7653	4	Blue Suede	$50.00
125	1154	4	Red Boots	$100.00
125	8763	3	Men's Work Boots	$45.00
157	7653	2	Blue Suede	$50.00
169	3342	1	LCD-40 inch	$1,000.00
169	9987	2	Blu-Ray Player	$400.00
178	2254	1	Blue Jeans	$12.00
188	3342	1	LCD-40 inch	$1,000.00
188	8763	4	Men's Work Boots	$45.00
201	1154	1	Red Boots	$100.00

Figure 4.49

Splitting a table to solve problems. Problems with repeating sections are resolved by moving the repeating section into a new table. Be sure to include the old key in the new table so that you can connect the tables back together.

the customer name, address, phone, city, and so on. Each entry in the transaction table for a customer would duplicate this data. In addition to the wasted space, imagine the problems that arise when a customer changes a phone number. You might have to update it in hundreds of rows.

The problem in this case is that the customer data does not depend on the primary key (SalesID) at all. Instead, it depends only on the CustomerID column. Again, the solution is to place this data into its own table. Figure 4.51 shows the split. Splitting the table solves the problem. Customer data is now stored only one time for each customer. It is referenced back to the Rentals table through the CustomerID. The same rule applies to Salespeople, resulting in the fifth table.

The five tables you created are listed in Figure 4.52. Each table is now in third normal form. It is easy to remember the conditions required for third normal form. First: There are no repeating groups in the tables. Second and third: Each nonkey column depends on the whole key and nothing but the key.

Note in that if the Customers table contains complete address data, including ZIP Code, you could technically split the Customers table one more time. Because ZIP codes are uniquely assigned by the post office, the city and state could be determined directly from the ZIP code (they do not depend on the CustomerID). In fact, most mail order companies today keep a separate ZipCode table for that very reason. For our small retail firm, it might be more of a nuisance to split the table. Although you can purchase a complete ZIP code directory in computer form, it is

SaleLine(<u>SaleID</u>, <u>ItemID</u>, Quantity, Description, Price)

ItemsSold(<u>SaleID</u>, <u>ItemID</u>, Quantity

SaleID	ItemID	Quantity
117	1154	2
117	3342	1
117	7653	4
125	1154	4
125	8763	3
157	7653	2
169	3342	1
169	9987	2
178	2254	1
188	3342	1

Items(<u>ItemID</u>, Description, Price)

ItemID	Description	Price
1154	Red Boots	$100.00
2254	Blue Jeans	$12.00
3342	LCD-40 inch	$1,000.00
7653	Blue Suede	$50.00
8763	Men's Work Boots	$45.00
9987	Blu-Ray Player	$400.00

Figure 4.50

Second normal form. Even though the repeating sections are gone, we have another problem. Every time the ItemID is entered, the description has to be reentered, which wastes a lot of space. There is a more serious problem: if no one has purchased a specific item yet, there is no way to find its description or price since it is not yet stored in the database. Again, the solution is to split the table. In second normal form, all nonkey columns depend on the whole key (not just part of it).

Figure 4.51

Third normal form. There is another problem with this definition. The customer name does not depend on the key (SalesID) at all. Instead, it depends on the CustomerID. Because the name and address do not change for each different SalesID, the customer data must be in a separate table. The Sales table now contains only the CustomerID, which is used to link to the Customers table and collect the rest of the data. The same rule applies to Salespeople.

SaleForm2(<u>SaleID</u>, SaleDate, CustomerID, Phone, Name, Address)

Sales(<u>SaleID</u>, SaleDate, CustomerID, SalespersonID)

SaleID	SaleDate	CID	SPID
117	3/3/2012	12345	887
125	4/4/2012	87535	663
157	4/9/2012	12345	554
169	5/6/2012	29587	255
178	5/1/2012	44453	663
188	5/8/2012	29587	554

Customers(<u>CustomerID</u>, Phone, Name, Address, City, State, ZIPCode, AccountBalance)

CID	Name	Phone	Street	City	Balance
12345	Jones	(312) 555-1234	125 Elm Street	Chicago	$197.54
28764	Adamz	(602) 999-2539	938 Main Street	Phoenix	$526.76
29587	Smitz	(206) 676-7763	523 Oak Street	Seattle	$353.76
33352	Sanchez	(303) 444-1352	999 Pine Street	Denver	$153.00
44453	Kolke	(303) 888-8876	909 West Avenue	Denver	$863.39
87535	James	(305) 777-2235	374 Main Street	Miami	$255.93

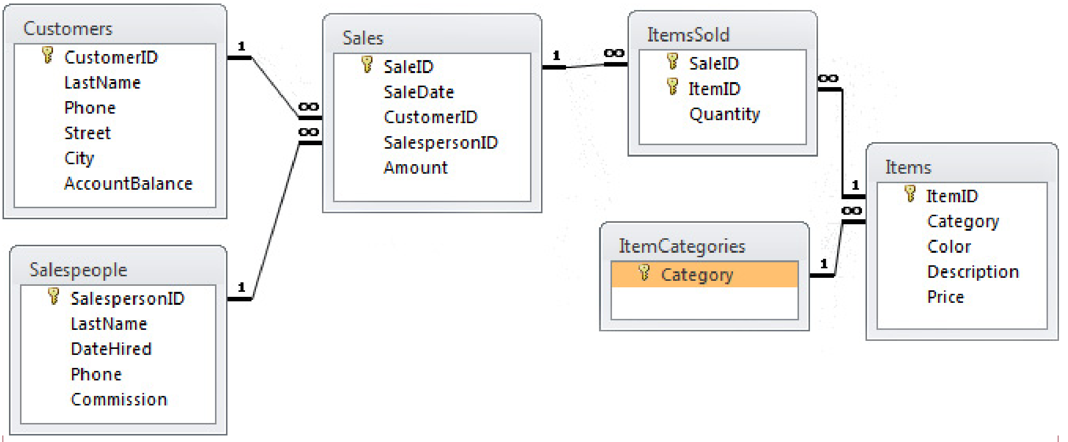


Figure 4.52

Third normal form tables. There are no repeating sections and each nonkey column depends on the whole key and nothing but the key. This figure also shows the relationships between the tables that will be enforced by the DBMS. When referential integrity is properly defined, the DBMS will ensure that rentals can be made only to customers who are defined in the Customers table.

a large database table and must be updated annually. For small cases, it is often easier to leave the three items in the Customer table.

Database Applications

How do you create business applications using a DBMS? Database systems typically have tools to help build applications. The tools make it relatively easy to create input forms and reports. Even if you never learn how to design a database, or become a programmer, you can learn to use these tools to build small applications and customized reports.

Data Input Forms

Rarely is data entered directly into the database's tables. Instead, input forms are used to enter some data automatically and to present a screen that is easier for users to understand. It is common to use colors and boxes to make the screen easier to read. Input screens can be used to perform calculations (such as taxes). Longer descriptions and help screens can be included to make it easier for the user to remember what goes in each column. A sample form from the Rolling Thunder Bicycles case is shown in Figure 4.53.

Many times, input screens look like older paper forms. Consider a typical order form, which first collects customer information such as name and address. It also contains lines for items ordered, descriptions, and prices. These are usually followed by subtotals and totals. If these forms exist on paper, it is easy to create them as a DBMS input screen. If you are creating a completely new form, it helps to draw it on paper first to get a feel for what you want it to look like.

Most input forms begin as a screen that is empty except for a menu line or some other help message. Three types of information can be placed on an input screen: (1) simple text, (2) input blanks, or (3) data retrieved from the database. A Windows-based DBMS can also include pictures, graphs, sound, and video.

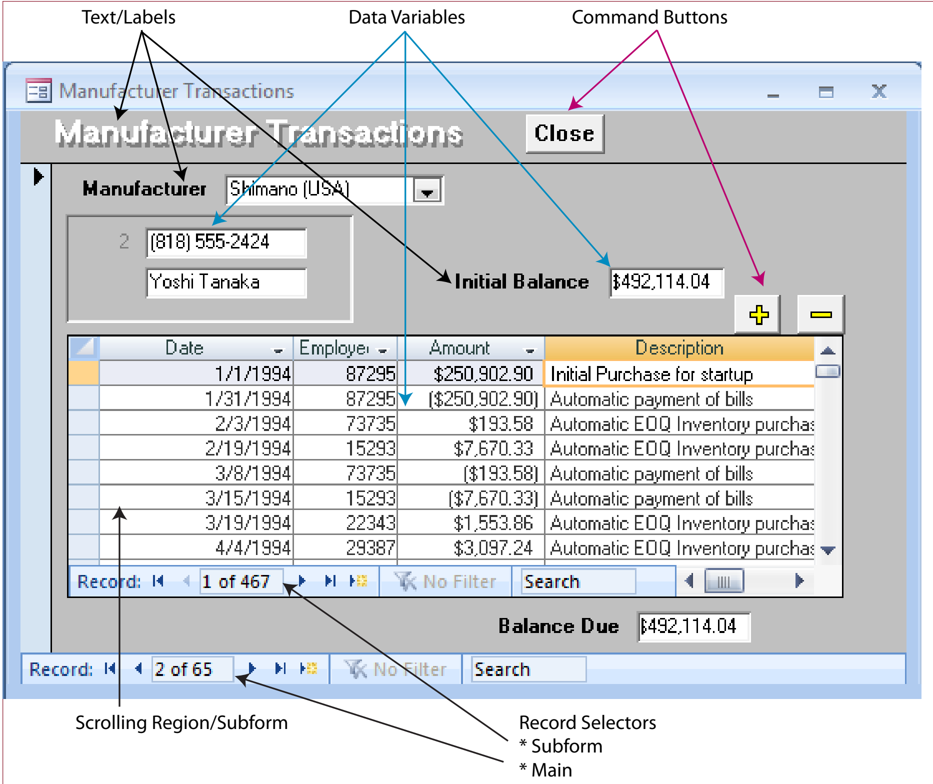


Figure 4.53

DBMS input forms. Input forms are used to collect data from the user and perform basic computations. Subforms or scrolling regions are used when there is a one-to-many relationship.

Paper forms have labels to tell the user what is supposed to be entered into each blank. For instance, many paper forms ask for a name: NAME _________. The label (NAME) tells you what you are supposed to enter on the blank line. A DBMS input form works much the same way. The first step is to type in the various labels. Move the cursor to a spot on the screen and type in a label or sentence that will tell the user what needs to be entered.

Most database systems automatically enter some types of data, such as the current date. If necessary, users can change the date, but it saves time by enabling them to press ENTER to accept the displayed value. The same situation holds for sequential items like order numbers, where the DBMS can automatically generate each unique order number.

After you have typed in the basic labels, the next step is to add the data-entry boxes. Just as you would type a blank line on a paper form, you need to tell the DBMS exactly what data will be entered by the user. For instance, move the screen cursor to a position next to the Date label, and then tell the DBMS to enter data at that point. You will specify the name of the column where the data will be stored. You can also specify default values. A **default value** is a value that is automatically displayed by the computer. For the case of the date, the DBMS will let you enter a name like Date() that will display the current date.

Reality Bytes: JPMorgan Chase Needs Better Database Design

In late 2010, JPMorgan Chase bank had a problem with its online site for three days. For at least 24 hours, customers could not conduct any transactions. The problem was eventually traced to a third-party authentication system that relied on an Oracle database. Apparently, some files in the Oracle database were corrupted and through mirroring the corruption was spread to the replicated copies. These copies then affected several other systems including Automated Clearing House (ACH) transactions and some loan applications. It also took developers several hours to clean up the problems because a large amount of extra data was being stored in the authentication database that should have been located elsewhere, including customer Web usage data.

Adapted from Jaikumar Vijayan, "Oracle Database Design Slowed Chase Online Banking Fix," *Computerworld*, September 24, 2010.

When a DBMS prints out data, it can be formatted in different ways. You can control the way the data is displayed by using a format command. A date might be displayed as 10/24/2012 by entering the format MM/DD/YYYY. There are several common date formats; most firms tend to use one standard format. Note that many European firms use a format that is different from the common ones used in the United States. Most database software automatically picks up the regional settings from the Windows environment and displays dates in the local format.

The next section of the order form contains basic customer information. This data is stored in the Customer table, not the Orders table. When you select the Orders table, you might have to indicate that the Orders and Customer tables are connected to each other by the phone number. Now, place the text labels on the screen (customer name, address, etc.). Then place a data entry box after each label.

Next, you can add the Sales table; it is connected to the Orders table by the order number. Type in the column names for Item#, Description, Price, and Quantity. The DBMS input form will define this part of the table as a **scrolling region** or subform. To users, this subform will behave somewhat like a spreadsheet. They can see several rows at a time, and keys (or the mouse) will move the screen cursor up and down as users enter data into any row.

The only items entered in the Sales table are the Item# and the Quantity ordered. The Description and Price can be found by creating a look-up in the Items table. If the clerk using this screen types in the item number, the description and price will appear. With a good DBMS, it is possible to define a pop-up form or combo box in case the clerk does not know the number. This way, by pressing a certain key, a table listing each Item# and Description will be displayed in a window on the screen. The clerk can then scroll through the list to find the item.

Reports

Most of the time, the data listed in one table is not complete enough to help managers make decisions. For example, a listing of a Sales table might provide only phone numbers, item numbers, and the quantity ordered. A more useful report would print sales grouped by customer. It would also compute total sales for each customer. Because this report relies on data from several tables, it is best to base the report on a view.

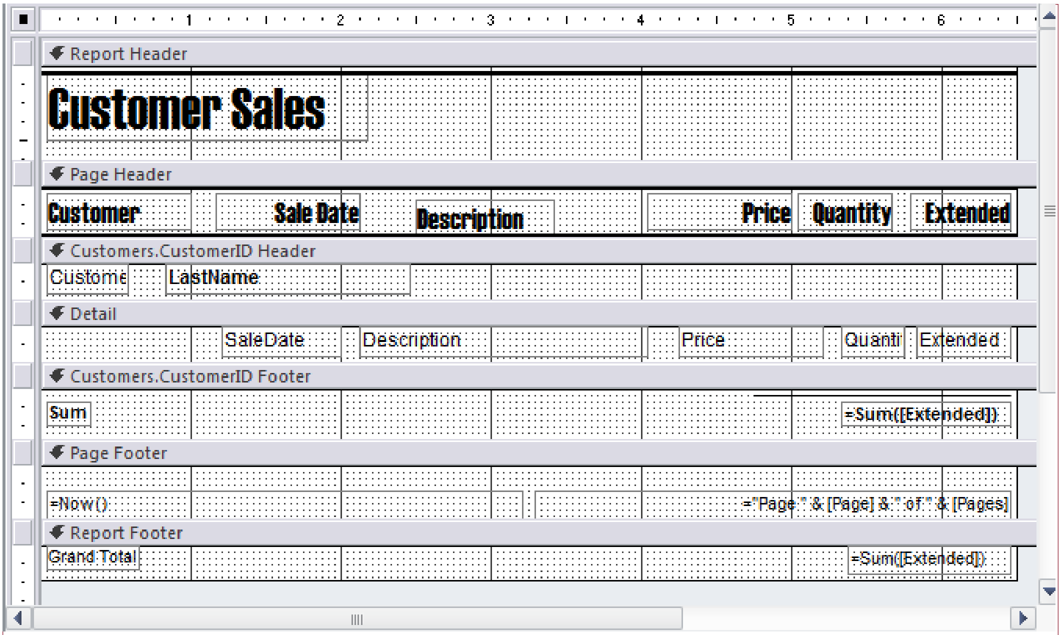


Figure 4.54

DBMS report writers. Reports are created in sections. The report header is printed one time at the top of the report. Data in the page header section is printed at the top of every page. There are corresponding page footers and report footer. Primary data is printed in the detail section. Data can be organized as groups by creating breaks. Titles are often printed in the break header with subtotals in the break footer.

The view for the sales report example needs four tables. An OrderReport view is created that joins the Customer table to Orders by CustomerID, Orders to ItemSold by OrderID, and ItemsSold to Items by ItemID. The DBMS will have a "create report" option to create the sales report. The report will be based on the OrderReport view. The report writer consists of a blank screen. You can put simple text statements anywhere on the page. You also can place data values on the page, and you can compute totals and make other calculations.

Most reports can be broken into categories. For example, there might be report titles that appear only at the front of the report (such as cover pages). Other information—such as the report title, date, and column labels—will be repeated at the top of each page. All of these items are called **page headers**. Similarly, there can be **page footers** at the bottom of each page. Reports may also contain group **breaks**. For instance, the sales report needs subtotals for each customer, so you need to break the report into subsections for each customer. Generally, you can specify several levels of breaks. For instance, you might break each customer order into totals by date. Each break can have a **break header**, a **detail section,** and a **break footer**. In the example, the customer name is printed on the break header. There is a detail line that lists the item information. The subtotals are displayed on the break footers. The report design or layout is illustrated in Figure 4.54. The report with sample data is printed in Figure 4.55.

To create this report, you first tell the DBMS that the report will contain one break based on customer phone number. You also define the variable Extended,

Customer Sales

Customer		Sale Date	Description	Price	Quantity	Extended
12345	Jones					
		3/3/2012	Blue Suede	$50.00	4	$200.00
		3/3/2012	LCD-40 inch	$1,000.00	1	$1,000.00
		3/3/2012	Red Boots	$100.00	2	$200.00
		4/9/2012	Blue Suede	$50.00	2	$100.00
		5/23/2012	Red Boots	$100.00	1	$100.00
Sum						$1,600.00
28764	Adamz					
		6/27/2012	Blue Jeans	$12.00	3	$36.00
		6/27/2012	LCD-40 inch	$1,000.00	1	$1,000.00
Sum						$1,036.00
29587	Smitz					
		5/6/2012	Blu-Ray Player	$400.00	2	$800.00
		5/6/2012	LCD-40 inch	$1,000.00	1	$1,000.00
		5/8/2012	LCD-40 inch	$1,000.00	1	$1,000.00
		5/8/2012	Men's Work Boots	$45.00	4	$180.00
Sum						$2,980.00
44453	Kolke					
		5/1/2012	Blue Jeans	$12.00	1	$12.00
		6/9/2012	Blue Jeans	$12.00	1	$12.00
		6/9/2012	Blu-Ray Player	$400.00	2	$800.00
		6/9/2012	LCD-40 inch	$1,000.00	2	$2,000.00
		6/15/2012	Blue Suede	$50.00	2	$100.00
Sum						$2,924.00
87535	James					
		4/4/2012	Men's Work Boots	$45.00	3	$135.00
		4/4/2012	Red Boots	$100.00	4	$400.00
		6/9/2012	Blue Jeans	$12.00	1	$12.00
		6/9/2012	Blue Suede	$50.00	1	$50.00
Sum						$597.00

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Figure 4.55

Sample report. Reports are often printed by groups or breaks with subtotals for each group. With a report writer, the layout, typefaces, and computations are easy to change.

which is price multiplied by quantity. Now you move the cursor to the top of the screen and type in the titles for the top of the page. Then place each column and variable on the report. You can format each item to make it look better. For example, you might want to format dates as MM/DD/YYYY so that all four digits of the year are displayed. Similarly, you can add dollar signs to the subtotals and totals.

When you have finished creating the report, you can print it. When you print this report, it should be sorted by customer name. The DBMS will also enable you to print the report so that it contains data just for one month. Notice that only five or six lines are needed to create a complex report. Without the DBMS report writer, it would take a programmer several hours to create this report, and it would be much harder to make changes to it in the future.

Putting It Together with Menus

If you are creating a database for yourself with just a couple of input screens and reports, you can probably quit at this point. On the other hand, for more complex databases or for projects other people will use, it would be wise to make the system easier to use. **Application generators** are tools that enable you to combine the various features into a single application. The resulting application can be used by selecting choices from a menu, much like users do with commercial software. The important design feature is that you can create the entire application without writing any programming commands.

Consider a simple example. As a manager, you need a sales report printed every day that shows the best-selling items. Every week you want a list of total sales for each employee to bring to your sales meetings. You also send letters to your best customers every month offering them additional discounts. You want to put your secretary in charge of printing these reports, but you do not have time to explain all the details about how to use the database program. Instead, you create a simple menu that lists each report. The secretary chooses the desired report from the list. Some reports might ask questions, such as which week to use. The secretary enters the answers and the report is printed.

Main Menu

1. Set Up Choices
2. Data Input
3. Print Reports
4. Utilities
5. Backups

Customer Information

Daily Sales Reports
Friday Sales Meeting
Monthly Customer Letters

Quit

Figure 4.56

Designing menus for users. Which menu is easier for a secretary to understand? When designing applications, you should organize the application to match the processes users perform.

The first step in creating an application is to think about the people who will use it. How do they do their jobs? How do the database inputs and reports fit into their job? The goal is to devise a menu system that reflects the way they work. Two examples of a first menu are shown in Figure 4.56. Which menu is easier for a clerk to understand? The one that best relates to the job. Once you understand the basic tasks, write down a set of related menus. Some menu options will call up other menus. Some will print reports; others will activate the input screens you created.

Once you know how you want the menu structure to appear, you fill in the menu templates in the application generator. To create a menu, you type in a title and fill in the choices. Then you assign an action to each choice. Usually you just pick from a list of actions and type in specific data such as the name of the report and how you want it sorted. When you are finished, the application generator creates the application.

Database Administration

What tasks need to be performed to keep a database running? Managing a database can be a complex job. Often hundreds of choices need to be made when the database is designed. Someone needs to be in charge of defining the data, making sure that all useful facts are captured, and managing security for this valuable asset. Databases have to be evaluated and fine-tuned on a regular basis. Someone has to keep track of these maintenance changes and decide when major updates should be installed. A **database administrator (DBA)** is usually appointed to manage the databases for the firm. The DBA needs to know the technical details of the DBMS and the computer system. The DBA also needs to understand the business operations of the firm.

The database administrator is responsible for all operations involving the database. These duties include coordinating users and designers, establishing standards, and defining the data characteristics. When new programs are created, the DBA makes sure they are tested and documented. The DBA also schedules backups and recovery, and establishes security controls.

In a few large companies, an additional person known as the data administrator (DA) is charged with overseeing all of the data definitions and data standards for the company. In this case, typically several DBAs are used to monitor and control various databases. The DA is responsible for making sure data can be shared throughout the company.

Standards and Documentation

In any company of moderate size, many different databases will be used by hundreds of workers. These databases were created at different points in time by teams of employees. If there are no standards, each piece will be unique, making it difficult to combine information from multiple databases or tables. The marketing department may refer to customers, but management calls them clients. The DBMS needs to know that both terms refer to the same set of data. Also, someone has to determine the key values for each table. Consider the Customer table. One department might assign identification numbers to each customer; another department might use customers' phone numbers, and a third department might use the customer names. To prevent confusion and to be able to combine information, it is best for all users to use only one of these methods to identify the customers.

Many standards are related to the database process. It is easier to use a database if all input screens have similar characteristics. For instance, the base screen might use a blue background with white characters. Data that is entered by the user will be displayed in yellow. Similarly, certain function keys may be predefined. ESC might be used to cancel or escape from choices. F1 might be used for help and F3 to display a list of choices. If each application uses keys differently, the user will have a hard time remembering which keys do what with which database.

Likewise, it is helpful to standardize certain aspects of reports. It might be necessary to choose specific typefaces and fonts. Titles could be in an 18-point Helvetica font, whereas the body of reports could be printed in 11-point Palatino. To provide emphasis, subtotals and totals could be printed in boldface, with single and double underlining, respectively.

One of the crucial steps in creating a database is the definition of the data. Many important decisions have to be made at this point. Besides the issues of what to call each item, the DBMS has to be told how to store every item. For instance, are phone numbers stored as 7 digits, or should they be stored as 10 digits, or perhaps stored with the 3-digit international calling code? Postal zip codes pose similar problems. The United States uses either a five-digit or nine-digit zip code, but is considering adding two more digits. Other countries include alphabetic characters in their codes. Someone has to determine how to store this information in the manner that is best for the company.

There are many other aspects of database design that need standards to make life easier for the users. However, whenever there are standards, there should be a mechanism to change these standards. Technology always changes, so standards that were established five years ago are probably not relevant today. The DBA constantly reviews and updates the standards, and makes sure that employees follow them.

Even though databases are easy to use, they would be confusing if the designers did not document their work. Picture a situation where you want to find information about customers but the designers named the table P*atrons*. You might never find the information without documentation.

Documentation can assume many forms. Most DBMSs allow the designers to add comments to each table and column. This internal documentation can often be searched by the users. Many times it can be printed in different formats so that it can be distributed to users in manuals. Because it is maintained in the database along with the data, it is easy to find. It is also easy for the designers to add these comments as they create or change the database, so the documentation is more likely to be current. It is up to the DBA to ensure that all designers document their work.

Testing, Backup, and Recovery

One advantage of the DBMS approach is that it provides tools such as report writers and application generators that end users can employ to create their own systems. Although it is easier for users to create these programs than to start from scratch, the programs still need to be tested. Corporate databases are extremely valuable, but only if the information they contain is accurate. It is the responsibility of the DBA to keep the information accurate, which means that all software that changes data must be tested.

Most companies would not survive long if a disaster destroyed their databases. For this reason, all databases need to be backed up on a regular basis. How often this backup occurs depends on the importance and value of the data. It is possible to back up data continuously. With two identical computer systems, a change made to one can be automatically written to the other. If a fire destroys one system, the other one can be used to continue with no loss of information. Obviously, it is expensive to maintain duplicate facilities. Many organizations choose to back up their data less frequently.

The main point of backup and recovery is that someone has to be placed in charge. Especially in small businesses, there is a tendency to assume that someone else is responsible for making backups. Also, remember that at least one current copy of the database must be stored in a different location. A major disaster could easily wipe out everything stored in the same building. There are some private companies that for a fee will hold your backup data in a secure, fireproof building where you can access your data any time of the day.

Access Controls

Another important task in database administration is the establishment of security safeguards. The DBA has to determine which data needs to be protected. Once basic security conditions are established, the DBA is responsible for monitoring database activity. The DBA tracks security violation attempts and monitors who is using the database. Because there are always changes in employees, removing access for departed employees and entering new access levels and passwords can be a full-time job.

Databases and e-Business

Why are databases so important in e-business? Many people still think of Web sites as simple pages of text with a few images. But e-business requires interaction with customers and the company data. Consequently, most e-business Web sites are connected to databases. In e-commerce, customers want to know if a product is in stock—this information is in the database. Similarly, customer, order, and shipping data have to be maintained and shared throughout the company. Other e-business sites use databases to provide services, store transaction data, and provide search and matching capabilities.

Designing an e-business database is no different than traditional business applications. However, the technologies for building Web-based applications are still evolving. Currently, two leading systems are being developed: Oracle/Sun

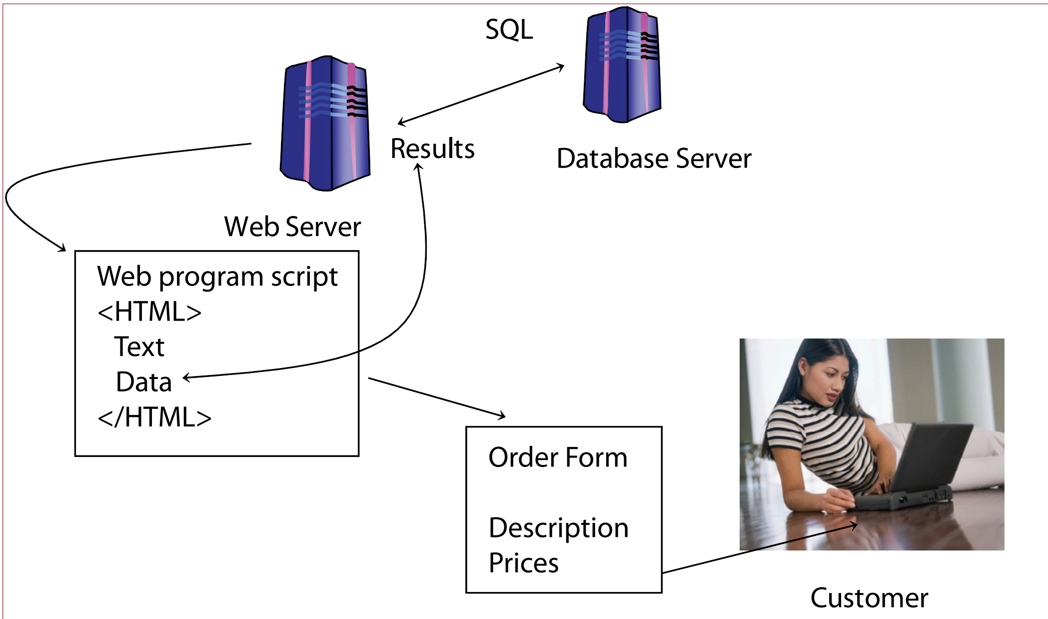


Figure 4.57

E-business database. When a customer requests a page, the server runs a script program that interacts with the database by sending queries and formatting the data to build a new Web page.

is championing a Java-based approach known as J2EE, and Microsoft is building the .NET platform. Databases are the heart of both systems, and both are server-based technologies designed to build interactive Web sites. Unfortunately, the two systems are completely independent and incompatible. If you build an application to run with one approach, you would have to completely rewrite it to use the other method.

Because the two approaches are so different, if you are building an e-business system, one of your first actions is to select one of these systems. In most cases, the J2EE approach runs on UNIX-based computers, but some versions exist for Microsoft-based systems. The Microsoft approach will probably only run on Microsoft servers, but some companies are experimenting with building versions that run on UNIX systems. Because the two systems are both new, it is difficult to evaluate them on technical grounds. The Microsoft approach offers a little more flexibility with its support for multiple languages. Microsoft .NET also provides a complete development environment with several easy-to-use tools that make it relatively easy for beginners to create database-oriented Web sites.

The basic approach is shown in Figure 4.57. Web developers create script pages that interact with the database. When customers request a page, the server executes the associated program script. The script sends queries to the database and retrieves the desired data. For example, the script might retrieve product descriptions, prices, and in-stock status. The data and images are added to the Web page and sent to the customer, who sees only the simple results.

Reality Bytes: Salesforce and Database.com

Salesforce.com is often listed as a leader in cloud computing—moving customer information to the Web. In late 2010, the company released Database.com, a cloud-based system largely based on Oracle's tools to support applications running on any platform. The system uses application programming interfaces (APIs) to deliver data to other systems. Essentially, the site becomes a giant database store to hold any information programmers need for Web-based services. The basic free version supports three users, 100,000 records and 50,000 transactions per month. Each set of 100,000 rows costs $10 per month, and each set of 150,000 transactions carries a charge of $10. They system does not really use a relational data model, which reduces its flexibility, but simplifies data storage and retrieval for some types of problems.

Adapted from Chris Kanaracus, "Salesforce.com Unveils Database.com," *Computerworld*, December 7, 2010.

Generally, the database runs on a separate server—which reduces the load on the Web server and makes it easier to handles backups and other database maintenance chores. However, with increasingly powerful servers, one server can handle smaller applications.

Cloud Computing

How are databases used in cloud computing? Several of the pioneers in cloud computing created their own special-purpose database systems. These are not relational database systems. For example, Google needs a way to store and retrieve huge amounts of data quickly. The company built huge sets of parallel servers, and then created a database system called BigTable that is designed to work over this distributed network. The system works well for storing documents and has built-in support for versioning. But it works nothing like SQL. For instance, there are no JOIN commands. Instead, you specify key values for the row, column, and time and store a single object at that location. BigTable can be accessed through the Google App Engine application. It is useful for storing complex document-type data. A more generic version of the database known as Hadoop is available from several open-source providers, and Facebook has created (and distributed) the Cassandra database system that works in a similar manner.

Amazon is another early Web company that provides cloud computing services. It currently offers three ways to store data: S3, SimpleDB, and Relational Database Service (RDS). S3 is primarily designed to store and deliver Web pages and other common Web objects. It is easiest to think of it as a file service. You upload files to the S3 servers, and build links to them on your Web pages. When users view your pages, the content linked to the S3 service is delivered from the Amazon network. Because Amazon has distributed servers and high-speed Internet connections, this content is delivered relatively quickly even under heavy loads. It is best used for storing large media files (music, video, and so on) that will be needed by many people. Pricing is based on the amount of data stored and transferred each month with no fixed costs. Amazon SimpleDB is similar to Google's BigTable. For starters, you need a programmer to use either one. You basically store and retrieve data by specifying an item name, an attribute name and the value. Differences exist between the Google and Amazon systems, but the

Amazon RDS (MySQL), U.S. East
1 Extra large instance
20 hours/day
20 GB/month at 50 million I/O per month
10 GB/month data transfer in
500 GB/month data transfer out
20 GB/month regional transfer
Estimated cost: $616 per month or $7400/year.

Figure 4.58

Amazon RDS (MySQL) estimated cost. Calculation is from Amazon's Web site calculator. Values are estimated and might not include all costs. But the example provides a mid-size database with T1-level data transfer for less than 10 percent of the cost of a single DBA.

underlying concepts are similar. More recently, Amazon introduced a cloud-based relational database service. It is largely based on the MySQL DBMS and uses the same syntax. Amazon has also indicated that it will implement an Oracle 11g database as well.

Microsoft sells the online service Azure which is a complete implementation of SQL Server as cloud computing. The system is built on multiple servers run by Microsoft administrators and your database can scale up to relatively large sizes. It is relatively easy to convert applications built using standard Microsoft development tools to run on the cloud servers.

The main benefit to using cloud computing for databases is that you do not have to run the hardware or software. That means you do not need to hire people to maintain and update everything, and you do not have the initial fixed costs. You are free to concentrate on the data and the applications. With most cloud database services, pricing is based on usage rates. If your company is starting up and you have small amounts of data and few users, monthly prices will be low. As the company grows and data increases, you will pay higher fees. But, you should be generating more revenue to cover those fees. And, most services include economies of scale so the rates decrease when you hit certain levels.

Cloud based databases are ideal for building Web-based applications. The reliability and scalability provided by the big service providers ensures that your applications will be available even as demand increases. Yet, the flexible pricing keeps the prices low during the start-up or low-use periods. Figure 4.58 shows an estimate of costs using Amazon RDS for a mid-size database. The transfer values are estimated to be about equal to a full T1 utilization rate. The point is that the annual cost is less than 10 percent of the cost of hiring a single IT worker to run the system—and one worker would not be able to provide 24-hour support. Another approach is to look at the cost of the T1 line—probably $300-$400 a month or half of the lease cost alone. Server and network hardware costs (3-year life) would easily make up the other half of the costs. So even if you ignore personnel costs, it is unlikely that a similar system could be configured in-house for this price.

On the other hand, the costs continue to increase even as your company becomes large. At some point, it becomes cheaper to pay the fixed costs of buying and running your own hardware, software, and networks. It is up to you as a manager to monitor the operating costs and compare them to the costs of running your own facilities. The cloud computing providers have expertise and specialize in providing their support, so it will be expensive to acquire that same level of expertise. Also, as the number of cloud providers increases, the competition should help to hold down prices. Documentation for the various services along with pricing models are available online, so it is straightforward to estimate the costs based on the amount of data and the monthly data transfer rates.

Summary

Everyone needs to search for information. Computers make this job easier, but someone must set up and maintain the databases to ensure their integrity. Relational database systems are increasingly used as the foundation of the information system. They make it easy to share data among users while maintaining access controls. Equally important, the databases are easy to alter as the organization changes. Sophisticated databases can handle all the data types in use today, not just simple numbers and text.

It is relatively easy for users to obtain data using SQL or query-by-example tools. Because SQL is a recognized standard query language, it is worth remembering the basic elements of the SELECT command. The syntax is easy (SELECT columns, FROM tables, WHERE conditions, ORDER BY columns). Just remember that whenever you use more than one table, they must be joined by related columns.

An important step in databases is to design them correctly. The trick is to split the data into tables that refer to exactly one concept. Most organizations have a database administrator to help users create the initial database tables, define standards, establish access rights, and perform backups and testing. Once the tables have been defined, users can create input screens, reports, and views by using graphical tools to draw the desired items on the screen.

It is important to choose the right tool for each job. Databases excel at handling huge amounts of data and sharing it with other users. On the other hand, spreadsheets are designed to perform calculations and create graphs. One indication that a problem should be solved using a DBMS instead of a spreadsheet is that several tables of data are involved.

Several database systems, using different technologies, are available as cloud computing services. These services provide scalability in the amount of data stored and transferred across the Web, with almost no fixed costs. But they can be expensive for some applications so managers must compare the in-house fixed costs to the total variable costs of using a cloud service.

A Manager's View

Every business has to store data. Every manager needs to do research. Sometimes you will have to summarize and evaluate transaction data. Sometimes you will use external databases to evaluate the industry and your competitors. Database management systems provide important capabilities to managers. One of the most useful is a query language, such as QBE or SQL, that enables you to answer questions without the need for hiring an MIS expert. A DBMS also speeds the development of new systems and provides basic features such as report writers and input forms.

Key Words

application generator
BETWEEN
break footer
break header
break
column
composite key
concurrency
data independence
data integrity
database administrator (DBA)
database management system (DBMS)
default value
detail section
LIKE
normalization
one-to-many
page footer
page header
primary key
QBE
query by example
row
scrolling region
SQL
table
view

Web Site References

Database References	
Computerworld data Management	www.computerworld.com/s/topic/173/Databases
eWeek Database	www.eweek.com/c/s/Database/
Car Shopping Services	
America's Automall	www.automall.com
Autobytel	www.autobytel.com
AutoNation	www.autonation.com
AutoTrader	www.autotrader.com
Carmax	www.carmax.com
Dealer Net	www.dealernet.com
Edumnds	www.edmunds.com
Kelley Blue Book	www.kbb.com
Vehix	www.vehix.com

Review Questions

1. How is data stored in a relational database?
2. What are the main benefits of using databases to build business applications?
3. What four questions do you need to answer in order to create a database query?
4. How do you join tables with QBE? With SQL?
5. How do you enter restrictions or constraints with QBE? With SQL?
6. How do you perform computations with QBE? With SQL?
7. Would you prefer to use QBE or SQL to access a database? Why?
8. What tasks are performed by a database administrator?
9. Why are forms (input screens) important in a relational database?

10. Do you think business users can create their own reports with a DBMS report writer? What limitations does it have?
11. Why are standards important in a database environment?
12. Why is a DBMS important for e-business?
13. How are non-SQL databases different from relational databases?

Exercises

C04Ex15.mdb

It is best to answer the first 15 exercise questions using a DBMS, but if one is not available, you can use the tables in the text and write your queries by hand. If you have a DBMS that handles both QBE and SQL, you should do the exercise with both methods. The number at the end of the question indicates the degree of difficulty.

1. List the customers who live in Chicago. (1)
2. List the items where the color is Blue. (1)
3. List the salespeople with a commission rate greater than 4%. (1)
4. List the customers with a last name that begins with the letter 'S'. (1)
5. How many customers have an account balance of more than $400? (2)
6. Which customers have purchased a Blu-Ray player? (3)
7. List all of the customers of salesperson West. (3)
8. List all of the items purchased by Customer Kolke. (3)
9. Which salesperson made the most sales by count? (3)
10. What was the total value of sales in May? (4)
11. Compute the commission owed to each salesperson in June based on the Sales Amount. (4)
12. What is the total amount of sales value in June? (4)
13. Which item category had the highest sales value in May? (4)
14. Write queries to test if the Amount value in the Sales table is correct for all sales. (5) Hint: Save a separate query to perform the computations.
15. Which items had no sales in June? (5) Hint: This query requires a LEFT JOIN or a subquery, which are not covered in this book.
16. You have been hired by a small county government office to track properties for tax purposes. The annual property tax rate is set by the local governments, but the assessor's office is responsible for tracking the value of each property. Whenever a house is sold, the sale price is reported to the office. Since this price is a concrete measure of the price, it has to be recorded permanently. In other cases, the assessor estimates the value of a property from its primary features, such as the lot size (measured in fractions of an acre), house size

(square feet), age (year built), neighborhood, and general condition. New values are estimated every year if a house has not been sold. If a property has not sold for more than five years, an assessor performs a simple inspection of the property and takes pictures from the road. Property owners can appeal an assessment to a board. The appeal date and any comments are recorded. The data is currently recorded on a form organized by each property. Recently, the office has been assigning GPS coordinates (latitude, longitude, altitude) to each property. Many do not have data yet but will be added when the properties are inspected. Create a list of normalized tables need to build this database.

Property ID		
Year Built Year Remodel Address Tax Code Area Zone Code Subdivision Section	Construction Price Township/Range/	Latitude Longitude Altitude

Lot size House size Sewer Water Utilities	Bedrooms Bathrooms Fireplaces Garage Basement

Property Description

Year	**Valuation**	**Method**	**Comments**

Appeals

Date	**Claimed Value**	**Resulting Value**	**Comments**

17. A friend has asked for your help in training for a triathlon. No, you do not have to run with her at 5 AM. She wants a personal log to track her progress and well-being. She has been writing entries in a journal, but she wants to be able to plot the data and compute totals. The basic layout of her existing log is shown in the form. For each day, she tracks the distance and time of each

run, bike ride, and swim. In all three cases, distance is recorded in miles; but often includes fractions. Eventually, when she plots the data, she wants the ability to exclude some days. For instance, one day her bike broke and she had to run home, so the time would not match with the others. She usually records her basic meals and estimates the total calories for the day. For the health category, she estimates the number of hours of sleep she gets at night, but the other entries are subjective comments and notes about the day.

Date	Run	Bike	Swim	Food	Health
Sunday	Dist. Time Comment	Dist. Time Comment	Dist. Time Comment	Breakfast Lunch Dinner Snacks Calories	Sleep Illness Comments

18. Using your experience in a job, school, or any organization; identify a problem that could be supported with a database management system—that requires at least three separate tables. Sketch a sample form.
19. Think about business or Web-based applications and identify a task that you believe could best be supported by a non-SQL DBMS. Explain why.

Technology Toolbox

20. For the Sales database, create input screens for Items, Customers, and Salespeople. Add an ItemCategory table that holds a list of the categories so you can add a combo box to the Items form to select from the list of categories.
21. Using a different design, rebuild the Sales form.
22. Add a button to the Sales form that enables users to open the Customer form to edit the data or enter a new customer.
23. Create an inventory report that lists all of the products; group them by category; and, within each category, sort them by price.
24. Create the customer sales report that is described in the chapter.
25. Create a start-up form that can be used as a menu. Begin in Design View and add buttons that open the other forms and reports. Use colors or images to enhance the appearance of the form.

Teamwork

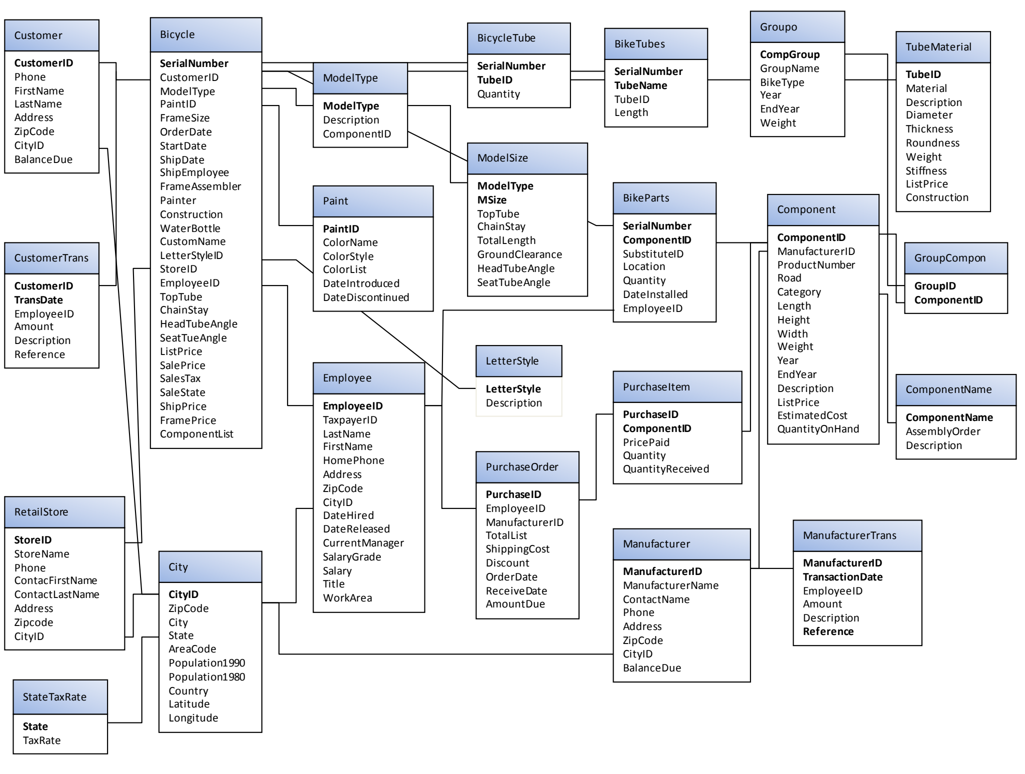
26. As individuals, each person should investigate a cloud-based DBMS in terms of capabilities and pricing. Combine the results as a team and select one tool that you would choose for a start-up Web-based company that anticipates starting with 1,000 customers a month and increasing to 10,000 customers a month within two years.

27. Assign the tables in the Sales database to each person on the team. As a group, identify the primary users of the system. Each person should then specify the security access rights for each user on each table: SELECT, INSERT, UPDATE, or DELETE.

28. Assume that you need to buy a DBMS to create a Web-based company. Research the components needed and have each person find information and evaluate a DBMS package. Try to identify costs as well as strengths and weaknesses of the package. Share the individual results and create a report that makes a recommendation.

29. With the cooperation of a local small business, create a database for that company. Note that you should verify the initial layout of the tables with your instructor or someone who has studied database design. Assign specific forms and reports to individual team members and combine the pieces.

30. Each team member should write up three business questions related to either the C04Ex15.mdb or Rolling Thunder database. Exchange the questions with the other team members, and then create the queries to answer each question. Share your answers.



Rolling Thunder Database

Create queries to answer the following questions. (*Difficulty level: 1 = easiest.*)

31. List all race bikes that sold in 2009 with a sale price greater than $5000. (1)
32. List all the purchase orders in 2008 with a total value greater than 200,000. (1)
33. List the employees hired after January 1, 1995 with a salary grade higher than 10. (1)
34. List the road bikes purchased in December 2009 with a FrameSize greater than 50 cm. (1)
35. List the paint colors introduced after 1995. (1)
36. List the retail stores in Delaware. (2)
37. List the customers (name and phone) who bought full suspension mountain bikes in December 2008. (2)
38. List all the race bikes ordered in 2010 that were painted with red in the color list sold to the state of New York. (2)
39. List the manufacturers who supplied mountain bike (MTB) forks in 2010. (2)
40. List the employees who painted race bicycles in January 2010. Hint: change the relationship from EmployeeID to Painter. (2)
41. Compute the number of bicycles sold by state for 2009. (3)
42. Which letter style was the most popular for Road bikes in 2010? (3)
43. What was the average discount (ListPrice – SalePrice) given on mountain bicycles in 2009? (3)
44. Which manufacturer did RT buy the most components from by value in 2010? (3)
45. Which employee sold the most race bikes in March 2010 by count? (3)
46. By count, what was the most popular crank installed on full suspension mountain bikes in 2010? (4)
47. How many bikes were sold each month in 2010. Hint use the function Format(OrderDate, “yyyy-mm”). (4)
48. For 2009, was the average price of mountain bikes lower than the average price of full suspension bikes? (4)
49. What was the average effective sales tax rate (tax/SalePrice) by state in 2010? (4)
50. In 2009, did race bikes have more Cranks made by Campy or Shimano? (4)
51. Which customers who have purchased mountain bikes have also bought Road bikes at any time? (5) Hint: Create two separate queries and save them.
52. Which customers purchased two or more bikes in at least two different years? (5)

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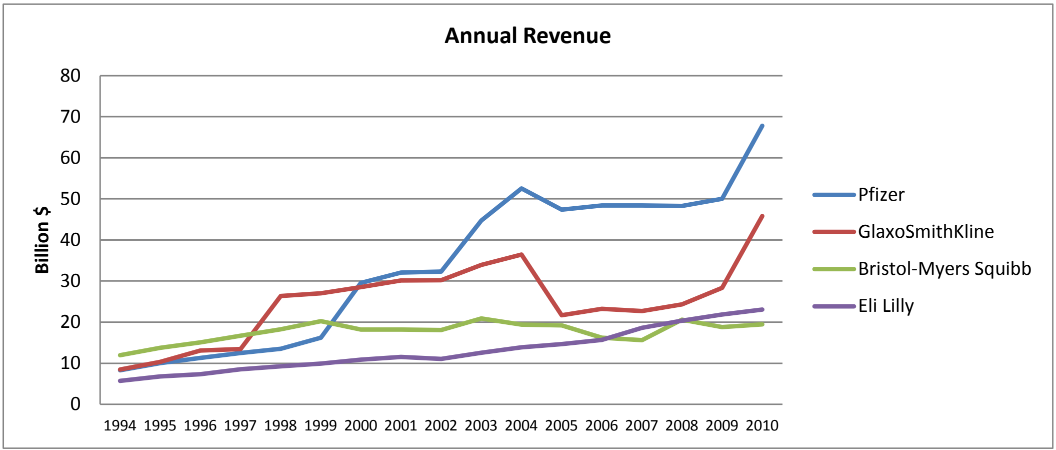
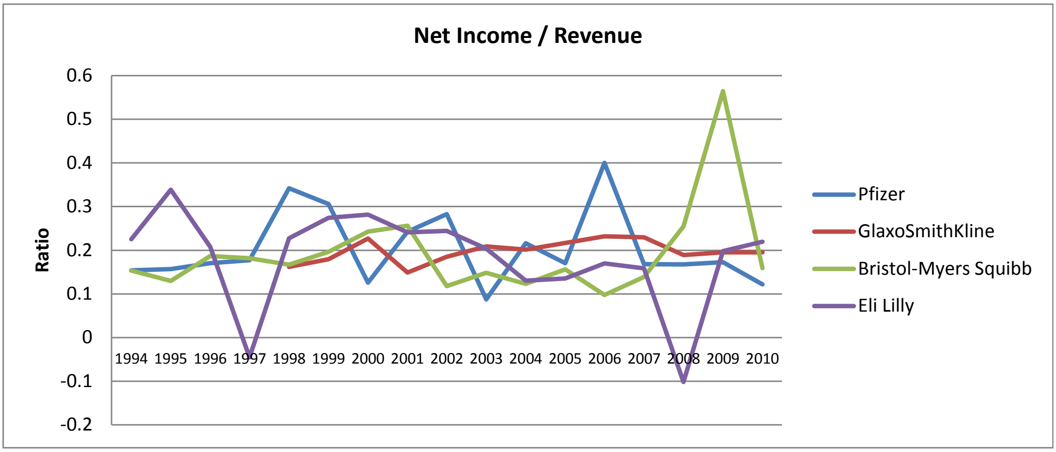
Cases: Pharmaceuticals

The Industry





The pharmaceutical industry has received considerable attention in the past few years. Several organizations, including the AARP, have criticized the industry for price increases on name-brand drugs that exceed the inflation rate. The AARP reported that prices have increased by 6 to 7 percent a year in 2002 and 2003 (Kaufman and Brubaker 2004). Prescription drugs often form a significant percentage of household budgets for elderly retirees. Yet the pharmacy industry notes that identifying and testing a new drug is expensive. On average, it takes 10 to 15 years and costs $800 million to bring one new drug to the market. And only one in five potential drugs makes it through the entire process. The industry spent an estimated $33.2 billion on R&D in 2003 (PhRMA 2004). On the flip side, the pharmaceutical companies spend about as much on marketing as they do on R&D (financial statements). In the same report, the industry observes that 10.5 percent of total health care dollars in the United States are spent on prescription drugs.

Drug Prices

The combination of high research costs, high risk, and the need to make a profit makes it difficult to set public policy. Profits encourage additional research and development to create new drugs. High prices keep the drugs out of the reach of some people who need them. Some governments have imposed price controls in an attempt to keep prices lower for patients. Canada presents an interesting example. Because trade with Canada is relatively unrestricted, U.S. patients have turned to Canadian pharmacies to fill their prescriptions. Even some state and local governments have tried to save costs by purchasing drugs from Canada, where the prices are held down by government rules (Schiavone 2003). Drug companies have staged an all-out battle to prevent the purchase of drugs from other countries. GlaxoSmithKline went as far as stopping sales to Canadian pharmacies (CNN 2003).

In 2004, the U.S. government introduced a Medicare insurance policy for purchasing name-brand prescription drugs. Participants have to sign up for the plan and pay a specified amount. The policies are sold by private companies, and the terms vary. Essentially, the policy covers a certain level of drug costs. However, with the copayments, limits on total value, and rising prices, it is not clear how many people will be able to benefit from the plan.

Research and Development

Research and development is a difficult process. Many times, luck and accidents play a role in creating new drugs. Yet companies need a huge infrastructure to take advantage of that luck. Research requires people and labs. Increasingly, it also needs information technology—in the form of databases, analytical tools, and collaboration software.

Finding a potential drug is only the first step (research). Development requires extensive testing, finding ways to deliver the drug with minimal side effects, and manufacturing it cheaply and consistently to narrow tolerances.

A pharmaceutical firm has to recover all costs within the life of a patented drug. Once the patent expires, the drug can be manufactured generically, and the inventing firm no long makes any money. Since 2000, several of the leading firms have suffered substantial declines in revenue as their patents expired on several blockbuster drugs.

An interesting twist on pharmacy research arose in 2004. A couple of firms, particularly GlaxoSmithKline, were charged with withholding research data. All potential drugs have to go through clinical human trials to identify the specific gains and evaluate potential side effects. The drug companies provide the results of the studies to the Federal Drug Administration (FDA), which has to give final approval to the drug. In at least some cases, negative research was withheld. Many of the trials are somewhat secretive—neither patients nor physicians can be allowed to know which patients have the specific drugs. Consequently, it is relatively easy to bury negative results and only publish the positive ones. Of course, easy is not the same thing as ethical. As a result of substantial publicity in 2004, several agencies, companies, and people are pushing for a national registry of clinical trials—before they are started. This way, everyone can check on the progress—both good and bad (Martinez 2004).

Genetics is playing an increasing role in drug discovery and testing. Several specialist firms (e.g., Genentech) have been struggling for several years to use genetic modifications techniques to create completely new drugs. A few of the drugs have been successful, but the sub-sector has not yet matched its early promises.

Marketing

Pharmaceutical firms have substantially pushed the boundaries of drug marketing in the last decade. Originally, the firms relied on publications in medical journals to highlight the success of their drugs. Of course, sales representatives made direct calls to physicians to point out the results, offer comparisons with existing drugs, and answer basic questions. These activities are still important to the industry. However, the industry changed enormously when it began marketing drugs directly to consumers. The FDA has relatively strict rules about the contents of these ads, and it routinely monitors the ads and requires companies to alter the ads. Nonetheless, physicians are now bombarded with questions from patients about a new drug they saw on television. Of course, patients rarely read the fine print—telling about the side effects—and few can make comparisons among the various drugs. So, physicians have to spend time explaining their choices. The pharmaceutical industry points out that increased communication between doctor and patient is a good thing. But, there remain many unresolved questions about the effectiveness of the campaigns—other than to boost pharmacy company profits.

Increasingly, pharmaceutical firms are being asked to track drugs and shipments more closely. California and Florida both passed laws that will require the industry to track the entire supply chain of drugs from the manufacturer to the wholesaler and retailer. California's law takes effect in January 2009. The security company VeriSign has established a database that can be used to track ownership of drugs, and sales will not be allowed until the seller can verify its ownership of the drug. AmerisourceBergen, a drug wholesaler, is working with the pharmaceutical companies to develop the system. In the early stages, the companies are considering the use of RFID tags instead of simple bar codes to make it easier to read the data (Weier 2007). Many Schedule 1 drugs, such as the addictive painkiller OxyContin, are already tracked with RFID tags. Pfizer also announced that to reduce thefts and "diversions" to drug dealers, it would begin tracking bottles of Viagra (Carr and Barrett 2005).

By 2011, pharmaceutical firms began changing their approach to marketing. The firms were facing declining profits, loss of patents, and the fact that physicians do not like being interrupted. By 2010, about 25 percent of physicians put themselves on "do-not-see" lists and about 75 percent of sales rep visits did not result in face-to-face meetings. So tens of thousands of sales reps were eliminated, and largely replaced with Web sites, iPad apps, and other digital tools. Older-style Web sites were discontinued in favor of interactive sites that enable physicians to ask questions, or get information from online reps (Whalen 2011).

Information Technology Needs

The pharmaceutical industry runs on data, information, and knowledge. The research departments generate and need to scan enormous amounts of data. They experiment and produce papers that disseminate knowledge. Researchers need to collaborate and share this data and knowledge. But the size of the companies, the variety of products, and the geographical dispersion all add complications. Additional data comes from physicians and even customers. On top of the research data, the marketers need to track salespeople, physician contacts, and marketing plans. The legal staff needs to monitor progress, evaluate patent documents, and shepherd thousands of documents through the FDA approval process. On top of all that, the CFO and CEO have to run the business—watching the financial data and creating the standard business reports.

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Case: Eli Lilly and Company

Eli Lilly (ticker: LLY) is one of the leading pharmaceutical companies. Founded in 1876, the firm now has more than 46,000 employees (www.lilly.com). Like other pharmaceutical firms, Lilly is dependent on revenue from blockbuster drugs. When patent protection expires for a blockbuster drug, as it did for Lilly's Prozac in the early 2000s, revenue and profits drop. The challenge for companies is to fill the pipeline with new drugs that will provide a new revenue stream. Research and development are key elements in this process. But finding new blockbuster drugs that solve a major medical problem is not easy. Lilly, like the other firms, is turning to biotechnology to help create and test new drugs. Lilly's genetically engineered insulin has been one of the first successes in this new line of research. Lilly is also hoping to capitalize on the erectile dysfunction sales by heavily advertising its Cialis drug directly to consumers.

Research and Development

R&D is critical to generating profits. But R&D has become considerably more complicated. Research is no longer performed by one or two scientists working alone in a lab. Instead, Lilly has thousands of researchers working on various projects. Each of the compounds being created needs to be shared across the company. Collaboration has become a critical success factor. Throw in the fact that most of the large companies have expanded through mergers. Now, how do you combine the systems and the people to provide effective collaboration? Charles Cooney, codirector of the Program on the Pharmaceutical Industry at MIT, observes that "R&D is useless unless it can be integrated into a bigger picture that helps you convert leads to drug candidates. The difficulty for the CIO is getting the team to work between the various disciplines needed to integrate the information in order to create knowledge" (Overby 2002).

Genetics is an increasingly important factor in pharmacy, and it adds many complications. Lilly, as well as the other firms, is looking at a future where drug selection may be tailored to a patient's DNA. Some drugs are more effective when specific genes are present. This level of knowledge will require a tremendous amount of information flow—both in R&D and in marketing.

In 2006, Lilly took an interesting step by outsourcing some data management and data analysis to Tata Consultancy Services (TCS) in India. TCS is well known for providing off-shore consulting for programming and other IT services. But this contract calls for scientific analysis using a facility dedicated to working on data analysis for Lilly. Steve Ruberg, Lilly's group director for global medical information sciences said that the agreement includes "gaining access to a global talent pool, increasing flexibility and scalability of our resources, and maintaining a global workflow that is operational 24 hours a day" (McDougall 2006).

Information Technology

Information technology with its connections to customers provides a new way to evaluate drug effects. All drugs go through scientific trials where physicians carefully monitor patients and evaluate side effects. But testing on a few hundred or even a thousand subjects does not always provide complete information. Historically, drug firms have relied on physicians to evaluate and report on effectiveness and side effects. Lilly's drug Strattera was the first nonstimulant treatment for children with attention-deficit hyperactivity disorder. On the basis of early trials, the company knew that sleepiness could be a side effect. To evaluate the drug when it was released to customers, Lilly designed a customer relationship management system to track customer contacts through its call center. With the feedback from actual customer use, the company was able to identify that the sleepiness was minimized if the drug was taken at a meal and at night. Sidney Taurel, Lilly's CEO, notes that "we've seen that IT makes you more effective. It's a big shift. We've changed to seeing IT as an enabler of effectiveness" (Murphy 2004).

"Big shift" is right. When Lilly hired Tom Trainer as its first CIO in 1994, he found a mess—with 17 different IT organizations and minimal use of computers for business. By the time Trainer left in 1999 to head global IT for Citigroup, the technology had improved considerably. But IT was still largely used to reduce costs. CFO Charlie Golden says, "We had gone through quite a change in our perspective and strategy in IT. It was important to try to sort through what it would take to continue to change, but also to make IT a more integral part of our strategy" (Ewalt 2003). Roy Dunbar was chosen as the new CIO. He began as a pharmacist, had some business experience, but little experience with information technology. With some intense education, and a lot of humility, Dunbar learned the foundations of information systems. His ultimate charge was to find ways to use technology to support the strategy of the firm. For that, he needed everyone to start with a business perspective. One of the key tools his team created in 2000 was the Molecule Library. It is a knowledge management system that makes it easy for researchers to find information about chemical compounds being worked with in the company's pipeline. The system reduces research time from days to minutes. Another new tool, the Sample Identification Database, functions as a registry of all compounds being developed. The Gene Anatomy Made Easy (Game) project helps scientists identify DNA analysis without requiring expert help. Shaving a few hours a week off the research time of every scientist can help get projects to market earlier, saving billions of dollars in costs (Ewalt 2003).

In 2001, the IT department began expanding its use of SAP (its enterprise resource planning system) to improve connections to suppliers and customers. Combining the company's shipping, billing, and sales data makes it easier to track sales and keep on top of billing problems. The company also implemented a sales management system to provide better information to salespeople.

Coming from the pharmacy side of the business, Dunbar knew that it was critical for the scientists to not only understand the value of the technology but also define and shape it to make it useful. He notes that "even as the projects move into production, it's senior-level scientists who are championing the new tools and evangelizing about their benefits" (Overby 2002). To improve communication between the IT staff and scientists, the IT development teams hold meetings at least once every two weeks between the two groups. Moreover, Dunbar doubled his IT department staff to 2,700 people, with an emphasis on hiring people with dual computer science and biology or chemistry degrees. In 2003, Mike Heim was appointed as the new CIO. Mike began his career at Lilly as a systems analyst in 1979.

In 2008, Lilly signed an agreement with TopCoder Inc. to help build some of its large applications for global drug discovery operations. TopCoder sponsors worldwide competitions trying to attract creative programmers. Code written by the programmers is stored in libraries that can be used by sponsoring companies such as Lilly (Havenstein 2008).

From various reports, Lilly uses Amazon Web Services (AWS) to handle some computing tasks. Using the cloud services is faster than trying to buy and set up a new physical server. But, rumors also exist about issues surrounding the basic contract and potential liability issues (Vaughan-Nichols 2010).

In 2010, Lilly began reducing costs by eliminating 5,500 workers, including 340 information technology jobs in addition to 140 cuts due to layoff, retirement, and resignations; out of 1,250 IT workers (Sears 2010). By 2013, drugs generating half of Lilly's revenue will lose patent status and face competition from generics.

Marketing

Developing a new drug is only the first step to making a profit. Companies also have to convince physicians to prescribe the drugs. With competition, and a huge array of new drugs, physicians need to evaluate the benefits and side effects. In the past, drug companies had sales representatives call on physicians. But Brian Weed, global marketing and sales IT director for Lilly, points out that "doctor's offices are closing their doors to pharmaceuticals sales representatives and citing HIPAA and privacy concerns as reasons" (Greenemeier 2003).

Sales force management and customer relationship management software are becoming more important at the pharmaceutical firms. Salespeople need to tell a consistent story to physicians. In terms of patients, Lilly is encouraging customers to contact the drug firm directly, instead of first going to their physician (Greenemeier 2003). The direct contacts can be beneficial in building brand awareness. As Lilly learned with Strattera, the call centers can provide more immediate feedback on actual usage and side effects. Ultimately, the process might require tighter links between the patients, physicians, and pharmaceutical firms, but those are not yet on the drawing boards.

Over the years, Lilly, and many other pharmaceutical firms, have faced bad publicity with various lawsuits. A common complaint is that the drug firms withhold or bury important information from physicians, usually regarding side effects. Thousands of plaintiffs claimed that Lilly's Zyprexa's anti-psychotic drug led to obesity and diabetes. In an interesting twist, a doctor and a lawyer involved in the case obtained many of the documents from plaintiffs and posted them on a Web site. Lilly attempted to obtain an injunction to (1) get the documents returned and (2) have all copies removed from all Web sites. Jack B. Weinstein, a federal judge in Brooklyn, ruled that the documents had to be returned, but it would be impossible to enforce any court order to prevent Web sites from displaying copies (Thomas 2007).

Questions

1. How does Eli Lilly use databases to improve efficiency?
2. What types of data does Lilly store in its databases?
3. How could Eli Lilly use additional information technology in marketing?

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Case: GlaxoSmithKline

GlaxoSmithKline (ticker: GSK) is one of the leading global pharmaceutical firms. Created through the merger of several firms over the past decade, it is headquartered in England and has over 100,000 employees worldwide. Like the other large pharmaceutical firms, GlaxoSmithKline (GSK) is suffering from the transition of its blockbuster drugs to generic status. It could easily lose $3 billion to $4 billion in revenue from its antidepressants Wellbutrin and Paxil and the antibiotic Augmentin ("Business: Glaxo" 2004. Because the company is headquartered in England, but almost half of its sales are in the United States, profits have suffered from the 35 percent depreciation of the dollar in 2003-2004. Nonetheless, CEO Jean-Pierre Garnier is optimistic. Through the mergers, he was able to trim $6 billion in costs. He has rearranged the research teams into divisions focused on specific areas (cancer, AIDs, and so on). More important, the company has 80 new products in the pipeline and half have reached advanced stage clinical trials ("Business: Glaxo" 2004).

GSK faces other issues. In 2004, the New York attorney general, Eliot Spitzer, filed suit against GSK for concealing negative data about Paxil. Spitzer contends that of all the studies Glaxo performed, only one generated the results they wanted to promote the drug. "Their effort to suppress the other studies was harmful and improper to the doctors who were making prescribing decisions and it violated the law" (Martinez 2004). The primary concern is that Paxil might lead to suicidal behavior if used in children under 18 years of age. Glaxo notes that Paxil was never approved for use by children in the United States and was not promoted that way. Glaxo spokesperson Mary Anne Rhyne notes that "there are many, many studies each year. It's impractical to believe that every company in the industry will be able to publish from every study" (Martinez 2004). But Glaxo's problems are compounded by a couple of internal memos. One noted that the company would have to "effectively manage the dissemination of these data in order to minimize any potential negative commercial impact." Another stated that "it would be commercially unacceptable to include a statement that efficacy had not been demonstrated" (Martinez 2004).

In response to these problems, several organizations have called for a clinical trial registry to track the progress of all trials and outcomes. The leading pharmaceutical companies are also backing the registry. However, the process is not that simple. Many of the Phase I trials are designed to test for side effects and do not focus on efficacy. So, some drugs might not appear to be useful. Some companies have noted that the National Institute of Health already maintains an online registry (www.clinicaltrials.gov), and it could be expanded to include results from all Phase III trials (Hovey 2004).

Relying on blockbuster drugs for profits is a risky strategy—particularly when bad news erupts concerning the heavily-used drugs. In 2007, some medical information was reported suggesting that GSK's second-biggest selling drug Avandia, a diabetes treatment, was linked in some way to a risk of heart attack. The data on both sides of the argument appeared weak and additional studies were being conducted. Nonetheless, physicians had basically stopped prescribing the drug for new patients. In managing the crisis, Jean-Pierre Garnier, CEO of GSK suggested five tips (Whalen 2007):

(1) Fight data with data.
(2) Communicate to employees. Daily phone calls are essential.
(3) Study doctor opinion to catch any changes.
(4) Put data on company Web site so everyone can see.
(5) Keep working on long-term business goals.

In 2007, it was estimated that GSK spent about $560 million on U.S. consumer ads; which is only a fraction of the $5.2 billion spent annually on U.S. pharmaceutical ads. But, in part to head off potential new regulations, Glaxo's CEO Andrew Witty said the company would cut back on television advertising. (Whalen 2009).

Information Technology in Research

In one sense, pharmaceutical R&D is similar to a university. Sharing knowledge within the organization is a key factor. The company generates and acquires information in the form of documents—some electronic, some in paper. GSK built a centralized library system (Lynx) to give researchers immediate access to the documents. The system provides access to over 2,000 electronic journals. Requests for paper books or articles are handled by librarians, who first try to locate the appropriate title within one of the company's nine libraries. If it is not available, they check with their outside suppliers. Of course, the company would prefer to digitize all paper documents, making it simpler to deliver the information, plus make it available to other users later. However, copyright limits the number of documents that can be digitized and prevents the company from disseminating them (Delaney 2003).

Genetics, particularly individual differences among patients, is one of the big target areas for pharmaceutical firms. Glaxo has forged a relationship with First Genetic Trust to study how variations in individual DNA can affect the efficacy and side effects of various drugs. Glaxo even built a proprietary high-speed network to communicate with First Genetic Trust. The company uses data mining and huge databases to compare drug effects across individuals. The main system runs on several HP 16L-Series 9000 UNIX servers. The company uses commercial applications to enable patients to provide informed consent and specify how their genetic data can be used. In general, only the genetic data without personal patient identifiers is given to Glaxo researchers (Greenemeier 2002).

In 2009, GSK was looking at many of the same cost issues facing other pharmaceutical firms—notably the number of profitable drugs losing patent status. VP of IT Ingo Elfering said that he was using this pressure to push for changes in the IT operations. The company signed a deal with Microsoft to shift standard e-mail, calendars, and collaboration services to Microsoft's hosted system (Lai 2009). The deal will transfer 100,000 employees from the existing IBM Lotus Notes to Microsoft Exchange, SharePoint, and Office Live Meeting. The company expects to reduce costs by 30 percent.

Questions

1. How does information technology help Glaxo in its research?
2. Would a national database of clinical trials prevent the problems that Glaxo had with approval of its Paxil drug?
3. Assuming that new drugs are developed that are tailored to specific DNA markers, how would you build an information system to take advantage of this data? How will you handle the privacy issues?

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Case: Bristol-Myers Squibb

Bristol-Myers Squibb (ticker: BMY) has headquarters in New York City and employs about 44,000 people worldwide. One of the company's recent innovations was the development of TAXOL to treat breast cancer. The company was able to create a synthetic compound that duplicated the original drug derived from the bark of the Pacific Yew (an endangered tree). In 2004, Bristol-Myers Squibb was approved to market the genetically created drug Erbitux in conjunction with ImClone Systems. You might remember the drug as the one that led Martha Stewart to be found guilty of lying to SEC investigators. Bristol-Myers Squibb also sells many consumer-level products (www.bristolmyers.com). In 2006, the company earned $1.6 billion on sales of $17.9 billion. However, 18 percent of sales revenue came from one drug: Plavix. The patent for Plavix expires in 2008 in Europe and 2011 in the United States (2006 Annual Report).

Research Data

Laboratory equipment today is generally automated. Often, it can be controlled by computers and most machines generate data that can be collected by computers. The catch is that machines can generate enormous amounts of data. BMY was having trouble keeping up with the amount of data generated. The BioAnalytical Sciences (BAS) group turned to the Scientific Data Management System (SDMS) developed by NuGenesis Technologies Corporation. The system collects all incoming data and reports and archives them to a central repository—which frees up the hard drives on the local workstations. The data and reports are then available to other researchers from a secure Web site. The system also provides access to the binary data, which is needed for compliance with federal laws. The system enables researchers to tag the raw data by researcher, project, analytical method, and so on. It collects data from diverse systems and makes the data accessible via a common interface. The BAS group connects to over 100 instruments in two sites in New York and New Jersey. The central server also backs up two main servers. Because the system consolidates historical data, it makes it easy for researchers to compare current results to older analyses. Data is stored in a secure Oracle database and marked with time-stamp and audit trail data so everything can be tracked. In a six-month pilot test, the system generated 5,000 reports. The system automates most data management tasks, freeing up time by researchers and IT administrators. More important, it enables greater collaboration because the data and reports are accessible throughout the company, regardless of the geographic location or software installed on a specific machine (DeVincentis 2002).

Knowledge is critical to pharmaceutical researchers. And knowledge is vastly more complex than simple data. How can a researcher in one location quickly find an expert in another division of the company? How does the research in one area compare to that by another department? Bristol-Myers Squibb purchased tools from LexiQuest to help solve these types of problems. LexiQuest is a linguistic search specialist, providing the ability to search based on information instead of just key words. LexiQuest Guide uses language-recognition technology to search documents based on everyday language. It semantically analyzes each document to evaluate its content. The two companies are also building a custom dictionary and search system to handle the specific terms used in pharmaceutical research (Jezzard 2001). In essence, the system reads the documents, enabling it to provide a more precise match to researcher requests. By providing more accurate and faster responses, researchers can save considerable time. And time is critical when you need to bring a new drug to the market.

Business Operations

Pharmaceutical firms are pressured by expiring patents, government attempts to reduce drug costs, and increased competition. Like any business, they are turning to information technology to reduce costs and improve the business operations. Bristol-Myers Squibb is turning to the Web for its purchasing needs. It acquired Ariba's Buyer e-procurement software in 2000, saving over $90 million a year within the first year. The system standardizes purchasing methods. Employees who need to buy something, such as a PC, check the suppliers and options on the Web site. Then a request for quote (RFQ) is posted on the Ariba network and suppliers bid for the contract. Employees can also use the system to purchase smaller items directly. The system aggregates the purchases where possible and orders in bulk. In 2001, as much as 16 percent of sales orders were conducted over the system (Yasin 2001).

In 2007, Bristol-Myers Squibb lost an important initial lawsuit. U.S. District Court Judge Patti B. Saris in Boston ruled that Bristol, AstraZeneca, and Schering-Plough were guilty of inflating average wholesale prices (AWP) for certain drugs. Some insurers use the AWP to establish reimbursement rates. On the other hand, Medicare stopped using the list in 2003, largely because of the inaccuracies that it perceived. Judge Saris wrote that "unscrupulously taking advantage of the flawed AWP system…by establishing secret mega-spreads far beyond the standard industry markup was unethical and oppressive" (Tesoriero and Korn 2007).

In 2008, Bristol faced the many of the same issues as the other pharmaceutical firms—and is also responded by cutting jobs. It cut 10 percent of its workforce in 2008 and again in 2009. The goal was to reduce costs by $2.5 billion (Wang 2008).

Questions

1. Can machines replace lab workers and scientists in conducting experiments and evaluating data? What problems might arise and how would you minimize the risks?
2. How does Bristol-Myers use information technology to reduce costs—particularly in purchasing?
3. Why is a central research database system so important to Bristol-Myers?

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Case: Pfizer

With almost $68 billion in sales in 2010, Pfizer (ticker: PFE) is the largest of the pharmaceutical firms (www.pfizer.com). As a research organization, the company has produced some well-known brands, including prescription drugs such as Celebrex, Diflucan, Lipitor, and Viagra. It also has a big presence in the consumer market with Benadryl, e.p.t., Listerine, Neosporin, and Rolaids, among others. In 2010, the company had 15 brands generating over $1 billion a year in sales (2010 Annual Report). It has 130 potential drugs in the pipeline (Overby 2002). But, $12 billion of revenue came from Lipitor, the biggest-selling medicine ever produced by any pharmaceutical company. But Lipitor faced competition from generics in 2010, and the company has had no success in creating another blockbuster drug. The company had been betting on a new drug torcetripib to boost "good" cholesterol—but a 15,000-patient study was cancelled when patients developed high blood pressure and started dying (Simons 2006). Pfizer officials tried to impress investors by revealing it had 242 research programs in progress. But it is difficult to say that any of the drugs will make it to market or produce the blockbuster revenue Pfizer depends on. Hank McKinnell, the CEO who engineered many of the mergers that made Pfizer a giant, stated in 2002 that "size helps. Chemical suppliers return our calls faster, we can run very large-scale global clinical studies, and we can try out the newest technologies and implement them rapidly in order to do things others can't. So, there are real advantages to scale." But the board of directors ousted McKinnell in 2005 when the promised gains did not appear. Additionally, some people are concerned that the big companies are creating fewer new drugs. Submissions to the FDA fell from an average of 41 per year to 27 per year, and many of those are created by smaller companies but licensed by the big four (Simons 2006). The company also created a Web site to enable investors and potential customers to track drugs in the pipeline (www.pfizer.com/pipeline). The concept of making this information openly available is a radical change for any pharmaceutical company.

Pfizer continued its expansion by purchasing Pharmacia Corporation in 2003, Esperion Therapeutics in 2004, and Vicuron Pharmaceuticals in 2005. Closing off a co-development agreement with sanovi-aventis, Pfizer purchased the worldwide rights to Exubera an inhaled insulation therapy. However, Pfizer did sell off its consumer products division to Johnson & Johnson for $16.6 billion in 2006 (2006 Annual Report). In 2010, Pfizer acquired Wyeth, another large pharmaceutical firm (2010 Annual Report).

The company faces many of the same problems as the other pharmaceutical companies. One of the biggest issues is how to integrate data and knowledge across the company—particularly when growth came through mergers.

Walter Hauck, vice president of worldwide informatics at Pfizer, knew he faced a huge problem in trying to integrate the many research departments. He needed to create tools that would support collaboration not only among the scientists but also among the lawyers and marketers who bring the drugs to market. He began with an ambitious task: integrate all of the changes at once. At La Jolla Labs in California, his IT team introduced one new application a week for six months. The scientists almost rebelled, saying that the sheer number of changes was taking away time from their research. Hauck heard similar complaints from many other divisions: "It was a lot of change to drop on people while expecting them to continue to deliver" (Overby 2002). With little control over introducing new tools, some employees were asked to sit through training sessions on the same product multiple times. Hauck knew it was time to implement a change management strategy. One of the keys was to standardize the process by creating a checklist, making sure that the business units needed the changes and understood the value. The lists also ensured that the developers captured the feedback and evaluated the pilot tests accurately.

Pfizer also tried to help employees by creating a new application to enter expense reports. But, the new system was harder to use than paper forms, help calls increased, and many people stopped using it. Joseph C. Schmadel Jr., senior director of business technology, observed that "that was an indication to us that something was wrong." To solve the problem, Pfizer brought in netNumina, Inc., a consulting firm, to rethink the user interface. By rebuilding the user screens and linking them to the back-end reporting system, the system became easier to use and still collected the necessary data. The system also creates a digital dashboard that provides summary statistics for executives (Weiss 2004).

Integrating data is critical to a company as large as Pfizer. The company had 14 different financial systems and wanted to combine the data into a data warehouse. The IT group built a data warehouse as a central repository, and then built links to each of the individual systems. But the IT department quickly encountered a problem. Each of the systems had different definitions for the data. It took months to clean up the data so that it could be combined and managed as a single source. Danny Siegel, senior manager of business technology, says, "We saw that we had to put in place some rigorous data standards. This kicked off a six-month, totally non-technical effort to devise a set of standards that allow users to slice and dice data in whatever context they need it" (King 2003).

Vita Cassese, VP of global business technology at Pfizer summarized the challenges the company faces in trying to reduce costs but still support research. She said "there are two opposing challenges. We need to drive a level of consistency and standardization to operate effectively while still fostering innovation." She also noted that the size of the business makes it more challenging to manage IT, noting "in many ways, it demands different approaches to data demand and information management. That makes for very big challenges, because we also need to drive down the costs of managing this information" (King 2006). Pfizer has tackled these challenges by centralizing the primary IT services, including ERP, the data center, help desk, and networking. But local support is provided by placing IT staff members into the various divisions around the world. Ms. Cassese noted that "IT still needs to be close to the business and have a deep, deep understanding of the business, but we also need a deeper level of discipline around how we deploy technology" to control the costs. To reduce costs, the company is trying to centralize much of the data handling. In 2005, the company initiated a project to consolidate 30 document management systems. The company is also trying to standardize desktop hardware. The document consolidation program is also driven by new federal rules that require greater sharing of data on drug trials and submission of labeling data in XML. Consequently, the system will use XML to store all of the data, integrating information across divisions in 26 nations.

Because Pfizer has acquired or partnered with many companies since the introduction of computerized database management, the company has a staggering amount of legacy data. The difficulty is "to get the data into a shape where it can be easily accessed by researchers that span the globe and be nimble enough to be able to accept new data and new systems as more companies come in via mergers and acquisitions. In addition, they need to convince scientists that what they have is not just an archive of past experiments but also a rich resource of information for future drugs" (Derra 2004).

Pfizer, like many other pharmaceutical companies, is pushing to become more efficient in drug discovery, and is looking to its legacy data as a source of useful information and insights into new drug development. But the sheer number of legacy systems within even one research facility is overwhelming. Bhooshan Kelkar, PhD, advisory software engineer at IBM Life Sciences, Dallas, says that the comments of a colleague speak to the enormity of the issue. "He was working with a big pharmaceutical company last year and reported that they had 500 legacy applications just in their discovery and clinical area…It was costing them 50% of their IT budget every year, just in maintenance and reconciliation of different legacy systems. That is huge." The key to unlock the power of mining legacy systems will be a combination of robust systems, standard methods, consistent data, and cultural change from within the drug discovery environment (Derra 2004). While the task is daunting, it is essential to new drug development to effectively catalog all the known compounds within Pfizer's extensive library in order to rapidly develop new pharmaceuticals or delivery methods. Transferring all of the corporation's legacy data to a common format is the best possible way for researchers to have quick access to important older data.

This same need for a universal data standard for collecting, sorting, and processing clinical trial data for FDA submission is currently occupying the entire pharmaceuticals industry. But the data-collection standards have been slow to catch on. However, in June 2004, a consortium of American pharmaceutical companies debuted a data-interchange standard for electronically submitting drug-approval applications to the U.S. Food and Drug Administration. This could speed the entire drug-review process, reducing the time between submission and FDA approval. The major pharmaceutical companies–including Eli Lilly, Merck, Aventis, and Pfizer–are the sponsors of the move, under the heading of the Clinical Data Interchange Standards Consortium (CDISC). Among the standards are a universal file structure and submission form, both within XML programming. CDISC previously developed standards for collecting lab data and clinical-trial data such as patient information. Those are designed to simplify the collection of clinical-trial data by pharmaceutical companies and the contract research organizations—such as Quintiles Inc.—that drug makers hire to manage clinical trials (Whiting 2004). The FDA will not require CDISC standards for drug-approval applications, but it has endorsed CDISC's efforts.

In 2007, a Pfizer employee used a company laptop to work at home. She installed a peer-to-peer file sharing application on the computer, and inadvertently made the entire machine a sharing device on the P2P network. The action exposed the personal data of 17,000 Pfizer employees, including Social Security numbers. Pfizer reported the breach and noted that various outsiders had downloaded data on about 15,700 employees (Vijayan 2007).

With 86,000 employees, and several thousand scientists in R&D, it can be challenging to coordinate and share information. So Pfizer customized Imaginatik's Idea Center tool to enable employees to submit ideas for new products or process improvements. Rob Spencer, a senior research fellow noted that the tool saved the company at least $20 million and helped solve hundreds of business problems (Rosencrance 2010). The goal is to use collective intelligence of the employees to attack difficult problems. The ideas or comments from one person can trigger ideas or solutions by other people.

Pfizer is facing the same cost-cutting challenges as other companies. The acquisition of Wyeth and King help increase total sales, but the company closed major research facilities in 2010 to achieve a 24 percent reduction in R&D costs. Pfizer's CEO Ian Read noted that "This is a fundamental change in culture. We have to fix this innovative core" (Loftus 2011).

Questions

1. Why did Hauck introduce so many new applications at one time? Why was it such a failure? Could you have predicted that outcome?
2. Why does Pfizer have so many different research systems and why is it so difficult to integrate them? What information technology tools might help?
3. How did Pfizer manage to have so many different financial systems?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Part 2

Business Integration

How are information systems used to integrate business data and support teams?

How do you protect data? How do you process transactions and what problems will arise? How do you integrate data across the organization and with suppliers and customers, including across the Internet? What tools are used to support teamwork?

Protecting computers and data today is no longer the job of just the security director. Because of the network-based threats, it is everyone's responsibility to be aware of potential problems and maintain good computing habits.

A hundred years ago, most businesses were tiny. As firms became larger, owners needed a way to manage and control the huge number of employees. Managers needed assistance with hundreds of daily operational decisions. Information technology provides the means to both share and protect data. It is relied on today to collect transaction data. Firms, even large ones, are increasingly creating enterprise systems that store financial and transaction data in a common central format—making it available to managers throughout the company.

The Internet offers new ways to extend companies into relationships with suppliers and customers. As a manager, you need to use information technology to reduce costs, create new sales opportunities, and organize the company.

Teamwork is increasingly important to managers—particularly in service organizations. Many tools have evolved to support groups of people working on documents and projects.

Chapter 5

Computer Security

Chapter Outline

What You Will Learn in This Chapter

- How do you protect your information resources?
- What are the primary threats to an information system?
- What are the primary security threats faced by individuals?
- What primary options are used to provide computer security?
- How do you protect data when unknown people might be able to find it or intercept it?
- What additional benefits can be provided by encryption?
- What non-computer-based tools can be used to provide additional security?
- How do you prove the allegations in a computer crime?
- What special security problems arise in e-commerce?
- If you have to track everyone's computer use to improve security, what happens to privacy?

National Football League

How do you keep data secure? Any professional football team has dozens of coaches and players—whether it is American football or European soccer, the characteristics are similar. Teams win through cooperation—that means everyone needs to share information. Coaches create playbooks, players provide feedback, and scouts identify weaknesses in opposing teams. All of this information has to be shared—so teams increasingly put the data onto computers. But securing this data is critical. Imagine the problems that arise if an opposing team gets a copy of the latest player health reports and new plays. Yet there are dozens of players and coaches, most of whom are not computer experts (to put it politely, since you really do not want to insult a 300-pound linebacker). Plus, coaches and players are sometimes replaced or switch teams.

Teams increasingly have to offer more data to fans. Some stadiums are now offering wireless networks. But security again becomes critical. How do you keep the fans from accidentally interfering with the coaching networks? What other threats can you think of? Hundreds of things can go wrong with technology, and someone has to be responsible for protecting the systems and creating contingency plans to handle problems.

Introduction

How do you protect your information resources? What are the major threats? Figure 5.1 presents some of the issues: outside hackers, people intercepting data, attacks on the server, physical threats to the equipment (including natural disasters such as floods and fire), and internal threats from employees, as well as privacy issues such as abuse of personal data. Think about the problem for a second: Who stole more money in 2010 (or almost any other year): teenage hackers or CEOs? Computer security has to prepare for both of these threats and others.

Security is a challenging problem for any business. It has become even more difficult with computing devices and data used everywhere in the company, on the Web, and around the world. Many companies rely on part-time and contract workers and need to give them access to data to complete their tasks. Monitoring tools are needed to watch for security and privacy issues. Advances in encryption and biometrics have provided powerful tools, but security ultimately comes down to people. If a worker is careless with passwords, or a programmer makes a mistake, or a network engineer falls behind on updates, or an auditor fails to test an account, holes are created that can be exploited by a thief or miscreant.

On the other hand, organizations can go overboard with security rules. Computer security is a balance—you must protect the data but still enable workers to do their jobs. The challenge is that IT security workers often see their jobs as identifying potential problems and preventing them from occurring. If an attacker steals data, the security staff is likely to be blamed, but if security is so tight that workers need to create workarounds to do their jobs, management might never see the problem, much less blame the security staff. So there is an incentive to try and security as tight as possible—even if it interferes with jobs.

Encryption plays an important role in protecting systems. It can also be used to authenticate the sender of a message. A key aspect of security and encryption is

Trends

Security has been an issue for thousands of years, from the simple substitution ciphers of Caesar to the importance of codes and code breaking in World War II. As more data was moved to computers, several complications arose. One of the biggest obstacles has been the need to identify people. Passwords have been the most common method, but they cause many problems. Newer technologies are available, but they require standards and people will have to agree to use them. Since security requires identifying people, increased emphasis on security can result in a reduction in privacy. Firms have collected data on consumers for years, but only recently have technologies advanced to the point where it is relatively inexpensive and easy to collect and analyze data on millions of consumers. Despite Hollywood's portrayals, the greatest security threats come from insiders. On the other hand, it used to be difficult to attack servers, and required programmers with a deep knowledge of the system. Today, with millions of computers connected to the Internet, it is relatively easy for beginners to download code from a site and run automated attacks against known bugs in operating systems. This technique is commonly used for creating denial-of-service attacks on Web sites. As e-commerce expands in importance, it becomes increasingly critical to develop a more robust Internet protocol that can identify and stop denial-of-service attacks. Many security tools exist to protect servers and to encrypt data transmissions, but it is difficult to stop denial-of-service attacks that rely on flooding the server.

the need to identify users. Consequently, the flip side of many security policies is the loss of privacy.

The Internet, e-commerce, and cloud computing add some challenging aspects to security. E-commerce requires that portions of the computer systems be available to consumers and other businesses. Greater business benefits are generated when Web sites are integrated with corporate data—such as inventory levels so customers can determine if an item is in stock. Yet, allowing public access to these systems creates greater security risks. Furthermore, since the Internet is a shared public network, data needs to be protected in transmission—to ensure it is not intercepted or altered. Wireless networks are even more open to eavesdropping and interception. Because of the public nature of the Internet, even a well-protected system can be brought down with denial-of-service attacks.

Tightening security can easily lead to a loss of privacy. One way to improve security is to completely identify every person and every activity performed. But even completely honest people are not willing to give up that much privacy. So, security faces another trade-off. These trade-offs are important, but they make the job harder for the corporate security expert.

Threats to Information

What are the primary threats to an information system? Information threats are often described in two categories: Physical and logical. Some people add a third category: Behavioral. Physical threats are things that go wrong with the hardware and buildings—particularly fires, floods, earthquakes, and hurricanes. Logical security refers to the ability to define and control access to

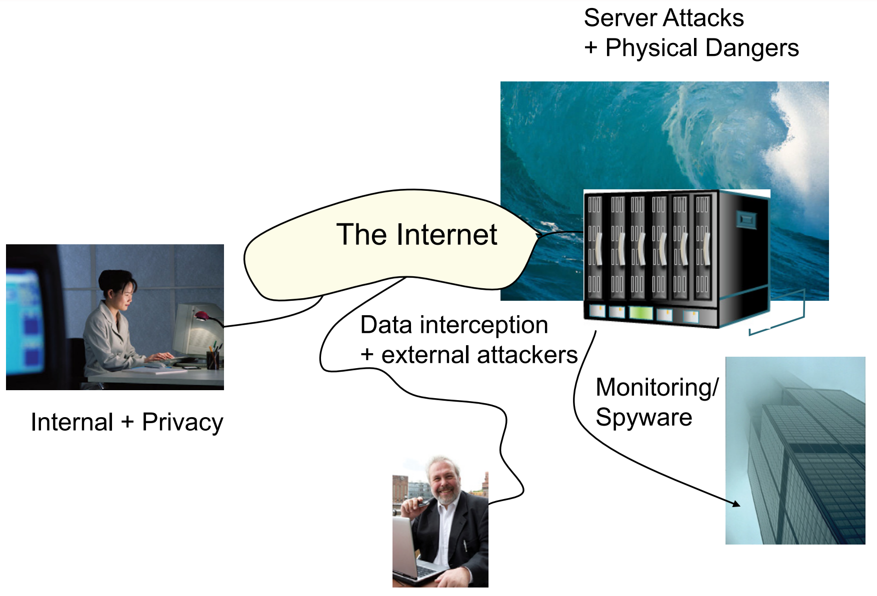


Figure 5.1

Security and privacy are important issues in the Internet era. People can intercept data, attack servers directly and indirectly, and companies routinely monitor all transactions.

data. Behavioral security refers to specific problems related to people. You might have strong physical and logical security, but employees who write their passwords on notes stuck to their computer, or give out private information over the phone can quickly defeat any security system.

Many potential threats exist to information systems and the data they hold. The complicated aspect is that the biggest information threat is from legitimate users and developers. Purely by accident, a user might enter incorrect data or delete important information. A designer might misunderstand an important function and the system will produce erroneous results. An innocent programming mistake could result in incorrect or destroyed data. Minor changes to a frail system could result in a cascading failure of the entire system.

You can detect and prevent some of these problems through careful design, testing, training, and backup provisions. However, modern information systems are extremely complex. You cannot guarantee they will work correctly all of the time. Plus, the world poses physical threats that cannot be avoided: hurricanes, earthquakes, fires, and so on. Often, the best you can do is build contingency plans that enable the company to recover as quickly as possible. The most important aspect of any disaster plan is to maintain adequate backup copies. With careful planning, organization, and enough money, firms are able to provide virtually continuous information system support.

A second set of problems arises from the fact that as technology changes, so do criminals. Today, only a desperate person would rob a bank with a gun. The probability of being caught is high, and the amount of money stolen is low. Do not take it as an invitation to become a thief, but the computer offers much easier ways to steal larger amounts of money.

Figure 5.2

Threats to information. By far, the most serious threats are from insiders: employees, mistakes, consultants, and partnerships. Businesses have to trust insiders to stay in operation, but you need to put limits on the access to data. It is possible for outsiders to break into most computer systems, but it is fairly difficult. Viruses are a serious threat both to data and security in general.

The threats mentioned in Figure 5.2 provide a useful way to organize some of the concepts of computer security. In particular, the physical threats need to be separated from the logical or data attacks.

Disasters

Fortunately, fires, floods, hurricanes, and other physical disasters do not happen too often. But when a disaster does hit a company's data center, it could destroy the company. Without advance preparations, the loss of a data center could shut down the operations. How long can a company survive without transaction processing?

Today, there are many ways to plan for and recover from disasters. Figure 5.3 shows a traditional method of using scheduled backups and a disaster recovery services provider. When computer servers are expensive, it makes sense to contract with a company to provide a facility and possibly spare computers. One level of support, called a **hot site**, consists of a fully configured computer center. Specific computer equipment is already installed and ready for immediate use. When the MIS staff declares a disaster, they install the backup tapes on the hot-site computers and use telecommunication lines to run the day-to-day operations. Another alternative is to contract for a **cold site**, which provides fully functional computer room space, without the computer equipment. If a disaster occurs, either the company or the disaster recovery services provider can arrange for the neces-

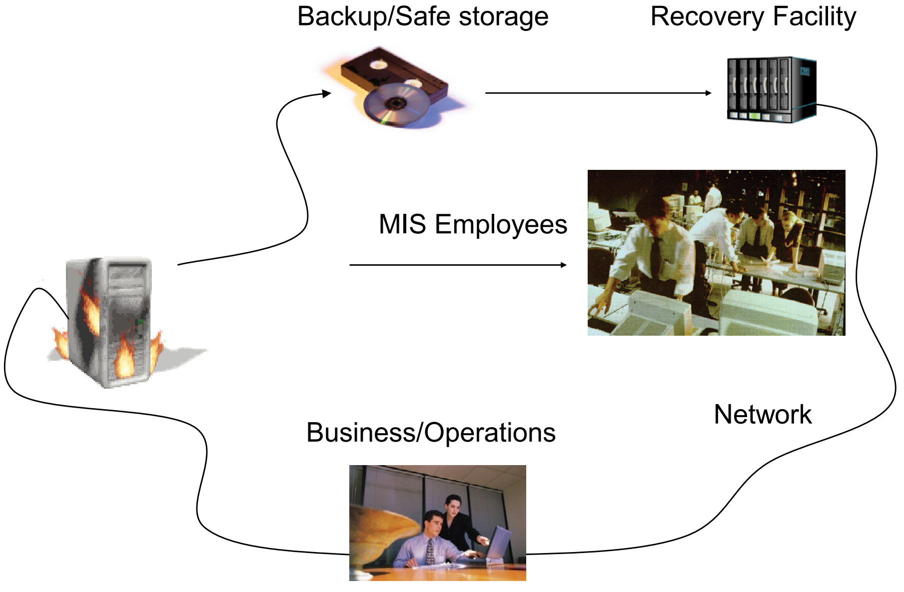


Figure 5.3

Disaster planning. 1. You have to back up your data. 2. You can contract with a disaster facility to have a site ready. 3. Create a detailed plan to move your MIS people and restore the system. 4. If a disaster strikes, shift the business network to the temporary facility. 5. Rebuild the original data center.

sary equipment to be shipped to the cold site. However, there might be a delay of several days before the new data center will be operational, so a cold site is often used in conjunction with a hot-site contract.

The problem with the traditional approach is that companies can no longer afford to run without computer support—even for a few hours. Fortunately, computer prices have also declined while network transfer speeds have increased. Consequently, it is possible for many companies to provide continuous backup—both in terms of data and processing capabilities. Figure 5.4 shows the basic concepts. Server clusters are created in separate locations and connected by a network. Each server contains redundancy in terms of multiple processors, disk drives, network connections, and even power supplies. If one component in the server dies, the others pick up the load instantly. Data is often stored on a network-attached storage area network, with its own duplication of drives and RAID configuration. Finally, in case a fire, flood, or network outage knocks out the entire facility, a second facility hosts another server cluster. Data from one site is continuously replicated to the second site. User applications are connected by a network so if one site goes down, everything shifts automatically to the backup site.

Large firms might build or lease their own remote sites with multiple server clusters. But even small companies can gain many of the same advantages are relatively low cost by using cloud computing. Large service providers on the cloud, such as Amazon's EC3, automatically provide servers in multiple locations. Companies can lease almost any level of computing which is handled off site by Amazon.

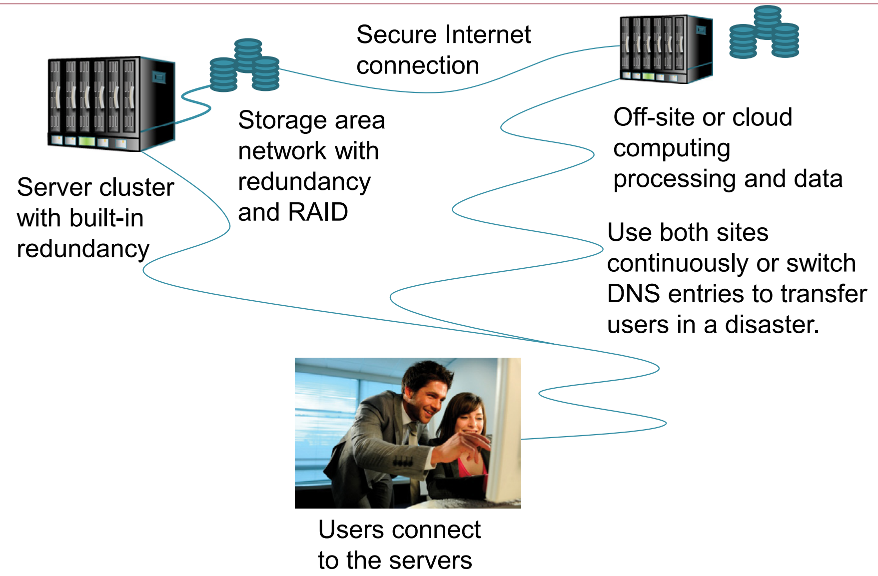


Figure 5.4

Continuous backup. Duplicate servers are installed at different locations and connected across a network—often the Internet. The servers themselves also have built-in redundancy. Data is written to multiple drives and multiple locations. If one site fails completely, the other site can instantly pick up the load.

Employees and Consultants

Employees are the heart of any company. Companies function and succeed by trusting their employees. Although almost all employees are honest and diligent, there is always the chance that one employee will use the company's knowledge, experience, and trust to misappropriate resources.

It can be difficult to identify people who might cause damage to the firm. Many companies today use psychological tests, background checks, and random drug tests to indicate potential problems. Most companies are wary of employees whose employment has been terminated. Businesses follow specific steps when employees leave, being particularly careful to remove the employees' access to company computers.

A more complicated problem arises with MIS employees. Programmers and analysts have to be trusted. Without them, there would be no software. However, it is generally best if the programmers are not the users of the program. Companies enforce a separation of duties among staff programmers and users. Think about what might happen if a bank teller was also responsible for writing the computer program used by tellers. It would be easy to use the computer to steal money from different accounts. Auditing transaction-processing systems is an important task for auditors.

Unscrupulous programmers have also been known to include "time bombs" in their software. Whenever the software runs, it checks a hidden file for a secret word. If the programmer leaves the company, the secret word does not get changed. When the program does not find the correct word, it starts deleting files. On large projects, these bombs can be impossible to spot (until they go off). Keep-

Reality Bytes: Hacking is Easy When You Tell Everyone the Answers

In a well-publicized case, attacker David Kernell broke into Sarah Palin's Yahoo e-mail account—largely by scouring the data that she publicly listed on various services. In 2010, George Bronk was arrested for using a similar technique to break into more than 3,200 e-mail accounts of women. He searched the victim's Facebook accounts for answers to security questions typically used to recover forgotten passwords at online sites. Once he was able to obtain the password, he changed the password, searched for nude photos and posted them on the victim's Facebook pages. He was charged in Sacramento Superior Court and faced six years in prison.

Adapted from Robert McMillan, "Nude Photos Stolen from Women's e-Mail Accounts," *Computerworld*, January 13, 2011.

ing good backups can usually minimize the damage. As a related side note, the software industry is pushing states to adopt a new set of laws (UCITA) that makes it legal to include a shutdown time bomb if a software company has a dispute with a business that uses its software.

Another danger area is that programmers might include a trap door or secret password that allows them to gain access to the software even if they leave the company. Sometimes these trap doors are installed innocently, to enable programmers to make corrections faster. The important point is to make sure they are removed when the system is permanently installed.

An interesting twist on passwords arose in 2008 when Terry Childs, the system administrator for the San Francisco network refused to give up the administrative username and password. Apparently the department suffered from management and personality differences and he argued that no one else was qualified to be an administrator on the network. After sitting in a jail cell for 12 days he gave the login credentials to the mayor. Later, he was convicted of interfering with a network and sentenced to 4 years in prison. Ignoring the personality issues, the case does point out the necessity of providing backup access to administrative accounts. What would happen in a large organization if a network administrator died in an accident?

An interesting class of threats to securing your data arises from negligence instead of deliberate actions by the users. For instance, employees might accidentally delete data. Or carrying disks, tapes, or even laptop computers past magnetic fields can sometimes damage the files. In these cases, the best bet is to have backups readily available. More complicated problems arise when laptop computers are lost or even stolen. In addition to the data stored on the machines, the files often hold passwords for corporate computers. Many laptops provide passwords and encrypt the data to minimize these problems. One other problem that falls into this category is a warning to be careful about how you dispose of old tapes, disks, and computer equipment. Businesses run similar risks when they send computer equipment out for repairs.

In general, the best way to minimize problems from employees stems from typical management techniques. Hire workers carefully, treat employees fairly, have separation of jobs, use teamwork, and maintain constant checks on their work. Consultants present the same potential problems as employees. However, consul-

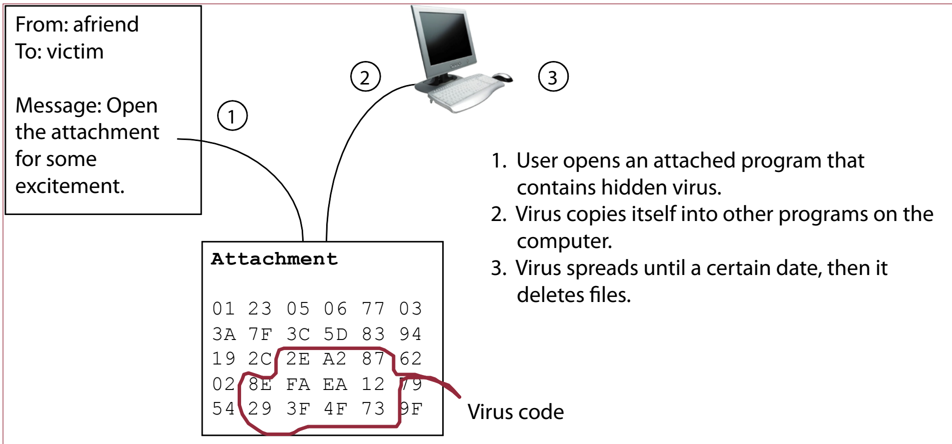


Figure 5.5

Virus activity. Once a virus is loaded on your machine, you will need an antivirus software package to remove the virus. Several versions are available at low cost. A virus can come from any software that supports executable code. Attachments sent through e-mail are currently the most common method of being infected.

tants tend to be hired for a short time, so the firm knows even less about them than about regular employees. Consultants are generally used for specialized jobs, so there may not be any internal employees who can adequately monitor their work.

Business Partnerships

As computers spread throughout every aspect of business, many companies share their data. For example, General Motors asks its suppliers to provide all information electronically. This electronic data interchange (EDI) means that business information is processed faster and with fewer errors. The problem is that in many cases, it means GM gives other companies considerable access to GM's computers and vice versa. For instance, if GM is thinking about increasing production, the managers might want to check supplier production schedules to make sure the suppliers could provide enough parts. To do it electronically, GM needs access to the suppliers' computers. To participate in business today, you must trust your partners. However, you have limited ability to evaluate all of their employees.

The issue of partnerships becomes more important in an Internet world of software and cloud computing. **Application service providers (ASPs)** on the cloud, such as NetSuite or Salesforce.com, run software on their Web servers and you store data on their sites—using only browsers to access the data and applications. Cloud computing has advantages such as: (1) experts set up and run the site so you do not have to hire specialists, (2) storing the data on the Web means it is accessible to your employees wherever they have Web access, and (3) you can start small and scale up to a reasonable size without hassles. From a security perspective, a potential drawback is that all of your financial data is stored on a site run by someone else. Of course, the reputation of the ASP depends on protecting your data and maintaining security, so it is probably safer than what a small business could handle independently; however, you should still investigate the ASP security procedures.

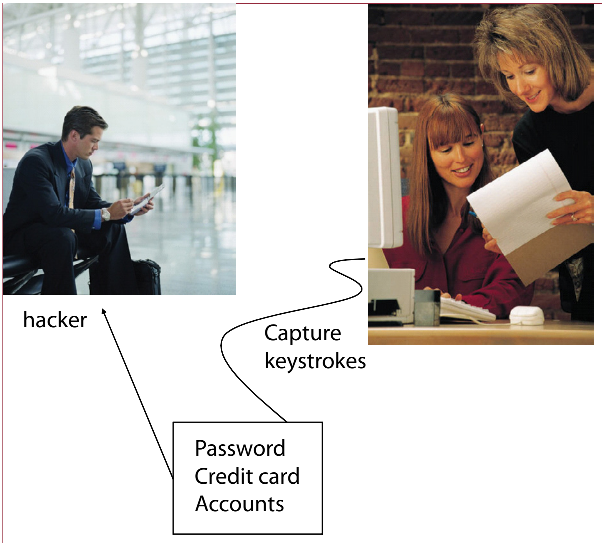


Figure 5.6

Spyware. Software loaded into your computer captures keystrokes, websites you visit, or other personal information. It transfers the data to a website run by a company or hacker who steals your money. The problem is particularly dangerous on public computers that are used by several people.

Outsiders

There is some threat from outsiders who might dial up your computer and guess a password. Using some common sense can minimize most of these threats. For example, in the 1980s, some groups gained access to computers because the operators never changed the default password that was shipped with the computer! The Internet causes additional problems because it was designed to give other people access to your machines. The key lies in providing people with just the level of access they need. The biggest problems today arise from a group labeled **script kiddies**, who download system scanning/attack software from the Internet and randomly search computers for holes. Another major problem with passwords is a technique hackers call **social engineering**. A hacker calls up a victim (you), tells some story, and convinces you to reveal your password. Never give your password to anyone.

In theory, modern computer security systems are effective and can prevent most outside attacks. The problem is that operating systems are complex software programs that have errors. Experts search these systems to find the errors, and ultimately, the vendor fixes the errors. However, this process can result in dozens of patches a year. Some businesses do not keep up with the patches, and some patches interfere with other programs and are not applied. Consequently, there can be thousands of systems connected to the Internet that suffer from published flaws. Software downloaded from the Internet can automatically search for these flaws and provide access even to inexperienced hackers. One key to protecting your servers is to make sure they have all the current operating system patches.

Reality Bytes: You Would Expect TSA to Understand Security

James Duchak was employed as a contractor at the Colorado Springs Operations Center of the U.S. Transportation Security Administration. He was a data analyst for about five years and updated the TSA servers with data pulled from the terrorist screening database and the U.S. Marshals Service Warrant Information Network. He learned in 2010 that he was being let go, and was training his replacement. His replacement noticed that Duchak deleted code that was used to format the birth dates for people entered into the system. In October 2010, Duchak, 47, pleaded guilty to the charges and was sentenced to two years in prison, $60,000 in restitution, and three years of supervised release. The restitution claim is interesting because the code should have been backed up and date formatting code is usually fairly easy to write.

Adapted from Robert McMillan, "Former TSA Contractor Gets Two Years for Damaging Data," *Computerworld*, January 12, 2011.

USB Drives

USB or flash drives are a useful technology for transferring files. But, that also makes them a prime target for carrying viruses and Trojans. Reports indicate that USB drives were a main vector for spreading the Stuxnet virus that appeared to be targeted to specific industrial machines, such as those used by Iran's nuclear processing. But, even simpler viruses, Trojans, and key-stroke loggers can be spread with USB drives. USB drives are physically small but can contain huge amounts of data or complex malware. Some organizations (including at times the U.S. military) have banned them, but they are now everywhere—including cameras and cell phones—so they are difficult to stop. Some software tools exist that can turn off USB ports in computers, or monitor them to prevent anyone from inserting USB drives.

On the flip side, USB drives can be used to improve computer security in some situations. In particular, if you need to use a shared or public computer, it is likely that the computer is already infected with any number of viruses or key-stroke loggers. If you only need to use the system to browse a few open Web sites, the risks are minimal. But public computers are risky when you need to connect to financial accounts. (Student labs might be a problem, but many schools are careful to monitor and remove common viruses.) USB drives have the ability to solve problem of infected public computers. You can install an entire operating system onto a USB drive along with software and a Web browser. Then if you need to use a public computer, you can reboot from the USB drive and run a system that you know is clean. You are only using the computer's processor and RAM, not its infected software. However, you should double-check the keyboard cable to ensure no one installed a physical device on the line to capture keystrokes. Of course, you need the operating system and licenses to install the software onto the USB drive.

Threats to Users

What are the primary security threats faced by individuals? Business face threats to data and servers, but they also face threats to user computers. Individuals face similar threats to their personal computers. Overall, the main threat is that an attacker can take over the computer—gaining administrator access to see all of the data and use the computer for any task. Several bad outcomes can arise from this threat. Your data and passwords can be stolen—resulting in someone impersonating you and stealing your money or trashing your reputation. By monitoring your use of the computer, the hijacker can steal credit card and bank account data. The attacker could also turn your machine into a zombie that is used to attack other computers. Or, it could be used to commit crimes—that would then be traced back and blamed on you.

Several methods are used to attack individual users. Some of them are difficult to detect and hard to prevent. All of them require users to be cautious and pay attention to their computers. Can you see the problem? Many people treat computers as simple machines that handle basic tasks and never need attention. Software and operating system vendors (notably Microsoft) have attempted to automate many of the maintenance tasks to ensure they get handled properly to protect user computers. But, from the perspective of society, it is not possible to protect all computers.

Virus/Trojan Horse

Everyone should know the ancient story of the Trojan Horse, where Greek soldiers hid inside a giant wooden horse which was then brought into the walls of the city of Troy—leading to the destruction and downfall of the city. In computing terms, a program or complex data file might contain a special section of code designed to take over your computer. When you run the program, the hidden code executes with your permissions and can take over your computer. A computer **virus** is a special Trojan Horse that first copies itself into other programs, and then tries to spread every time those programs are run. One complication is that many applications support macro programming languages, such as Microsoft's Visual Basic for Applications, where code is stored and executed within data files or Web pages. These programming languages provide powerful features to integrate applications but they provide even more opportunities for nasty code to sneak onto your computer.

As shown in Figure 5.5, the virus code can be difficult to spot. A virus can be picked up from many sources, but e-mail attachments are the prevalent method today. The obvious solution would seem to be the same as for the original Trojan Horse: Look inside the program to see if soldiers are hiding there. Of course, a person would never be able to look through the hundreds of thousands of files and programs on a computer by hand. Instead, antivirus software is used to scan your computer by looking through every single file. But the second complication is that it is difficult to recognize a virus. The most common approach is to keep a signature list of all known viruses and check every line in every file against every possible known virus.

Viruses and Trojan Horses remain a threat despite the use of antivirus software. The reasons are clear when you understand how the antivirus software works. For the most part, the software works on existing, known viruses. Anything new or anything that modifies itself can sneak through. Additionally, with the huge number of files and the growing number of known viruses, the antivirus software can take a substantial amount of processing time—which can slow down your computer. The software can also make it difficult to install, update, or create new software. Many commercial software packages even recommend disabling the antivirus software before attempting to install anything. Consequently, antivirus

Reality Bytes: Brute Force Password Attacks Using Amazon

Brute force attacks on passwords have always been a possibility—where a computer tests every possible combination of letters and numbers to find a password. But, with reasonable passwords, brute force attacks historically would take many years to find. The obvious solution is to split the task across multiple computers. Still, an attacker would have to find a way to get access to thousands of computers. With cloud computing, anyone can buy cloud computing time, such as that from Amazon's Elastic Compute Cloud (EC2) service. In 2010, Thomas Roth, a security consultant in Cologne, Germany, used a cluster of Nvidia graphics processors through Amazon to test 400,000 possible passwords per second. He used the system to break into a wireless network in 20 minutes at a cost of 28 cents per minute. With some improvements, he says he can break wireless passwords in 6 minutes. Roth noted that "The speed of computers is increasing incredibly fast, and so brute forcing will get faster and faster, and the new cloud offerings make parallelization of such use tasks easy and affordable,"

Adapted from Stuart J. Johnston, "Researcher Breaks Wi-Fi Passwords Using Cloud Computing Power," *eSecurity Planet*, January 12, 2011.

software can help clean files once a virus is identified, but it has not proven very useful in stopping attacks—particularly since new viruses are created every day.

Today, it is easy to create a virus—simply find a virus software kit on the Web, make a few changes, and send it to someone. You would need only minimal technical skills. Of course, it is illegal to create and release viruses and other destructive software (in most nations).

Instead, the best way to stop a virus is to avoid running software acquired from the Internet and to never open script attachments sent to you by e-mail—even if they appear to come from a friend. Be cautious, because some attachments that appear to be pictures are actually virus scripts. Most e-mail services now have filters that can block script attachments, but they tend to be heavy-handed and also block useful files.

Ultimately, the most important step with viruses is to make certain that you always have current backup files. Then, if a virus deletes your files, you can recover the data, run an antivirus software package, and remove the virus. It will cost you time, but at least you will save the data.

The problem with viruses and Trojan Horses is that they often install **spyware**—or software that sits on your computer and monitors all of your activity. It can capture your keystrokes and record Web sites visited, passwords entered, and credit card numbers. As shown in Figure 5.6, periodically, the spyware software sends the information to a Web site where it is collected by an attacker.

Viruses, worms (essentially viruses that do not destroy data), Trojan horses, and spyware are often called **malware**, because they are designed to do bad (mal) things to your computer system. Spyware tools are particularly dangerous on public computers—such as those at Internet cafés, print shops, or libraries. Someone could install the software and capture all of your keystrokes and passwords. You should avoid entering passwords and credit card data on computers that are shared with the public. Microsoft Windows includes software that scans your machine

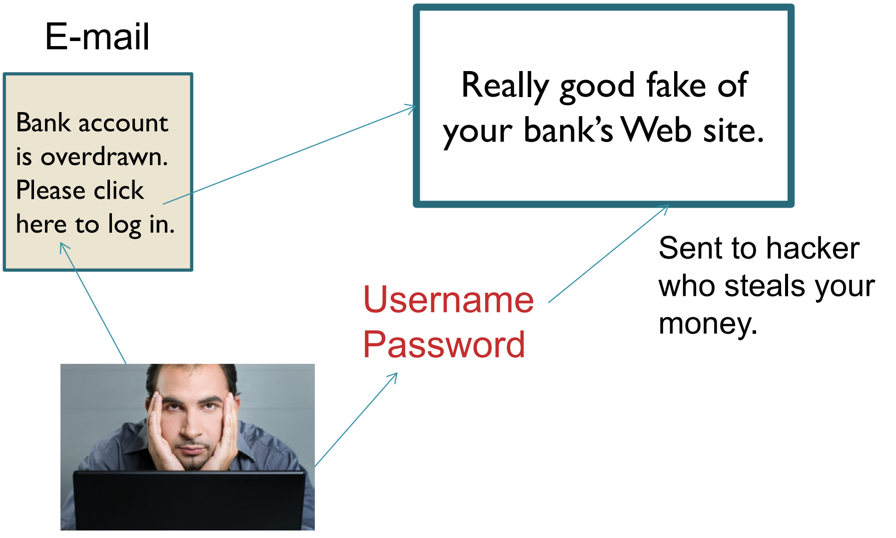


Figure 5.7

Phishing. A fake e-mail contains a link to a fake bank Web site. You inadvertently click the link and enter your username and password. The attackers running the site can now log into the real bank and steal your money.

for some known, dangerous spyware. You can also use the Windows Task Manager to show you what processes are currently running on your computer. If you recognize a malware tool, you can stop the process to shut it down. But you have to be careful, because a standard computer runs many processes. You need to decipher the cryptic names of the processes to understand which ones are good and which ones are bad. It is usually best to use a spyware tool—which contains a list of the known malware tools.

Phishing: Fake Web Sites

Attackers often want to gain access to your computer or at least your credit card and bank account numbers. One attack method is **phishing** for passwords. As a side note, news writers have been converting words beginning with "f" to "ph" ever since the 1970s episodes of phone phreaking—where hackers used various methods to make free phone calls. Figure 5.7 shows one basic method of phishing. An attacker sends mass e-mails pretending to be from a big-name bank. A certain percentage of users will click the link in the e-mail which takes them to a fake Web site that looks like the bank site but is actually run by the attackers. If you do not recognize the fake and enter your username and password, the attackers can quickly turn around and log into the real bank site using your credentials. From there, they can transfer all of your money to their own accounts. Hundreds of variations exist.

If you are always alert and moderately paranoid, you can avoid becoming prey to a phishing attack. Avoid clicking links sent by e-mail. Always double-check the URL of a site that asks for a login. Verify that the security certificate exists and is assigned to the bank. But, some fish are not as smart as others, or you might be tired one night and not pay attention and take the bait.

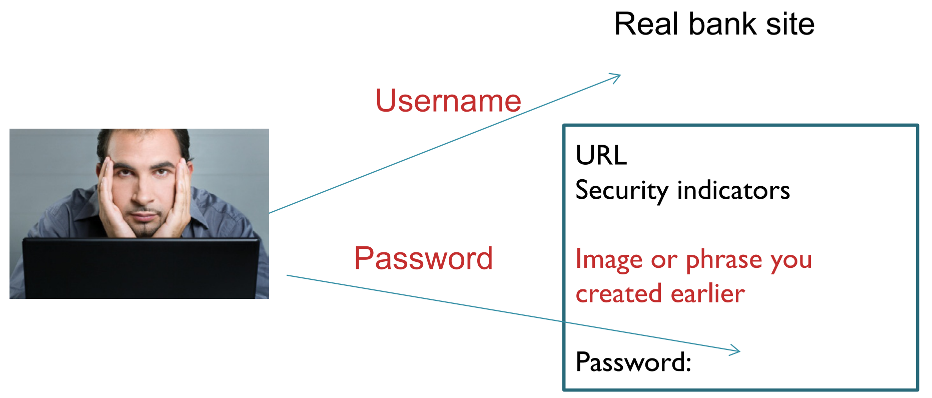


Figure 5.8

Two-step login. Customers enter an image or phrase at the real bank site. In future logins, the username is entered first, which retrieves the matching image or phrase. If the customers recognize the image, it is safe to enter the password. Fake/phishing sites would not have the correct image or phrase.

Banks have implemented some security features to make it easier for customers to recognize the real bank site versus fake sites. Figure 5.8 shows the basic process of a two-step login. Initially, customers select an image or enter a phrase that is associated with the username. These values are stored on the bank's server and would not be accessible to an attacker. During subsequent logins, the customer first enters the username or ID value for the account. The real bank site retrieves the matching image or phrase. When the customer recognizes the proper display, it is safe to enter the password. Of course, you should never use the same phrase or image for multiple sites. So, customers have to remember one more thing to log in. It is relatively easy for any business to implement a similar scheme, but it ultimately makes it more difficult for people to use the systems. And it raises the question of how far a company should go to protect customers from their own actions. Browsers have tried to implement warnings for known phishing sites, but sites can still get past the warnings. Ultimately, it comes down to people paying enough attention to avoid fake sites.

Updates and Patches

In the past couple of years, one of the favored methods of attacking your computer has been to exploit flaws in the operating system and software running on your computer. Software that was created with sloppy programming practices can create holes for outsiders to exploit. Many of the problems are caused by buffer overruns, where the program allocates a limited amount of memory for data and an attacker enters a carefully crafted entry that takes up more space than allocated. This extra data then overwrites the program code and your computer executes the attacker's code. Microsoft, Apple, and other software vendors have been working hard to find and fix these errors. Periodically, these vendors release patches to their software, which you need to load and install on your computer. The good news is that the companies are actively fixing the problems. The bad news is that every time they announce a problem, the attackers also learn of the issues. You need to immediately patch your computer before the attackers take advantage of the flaw.

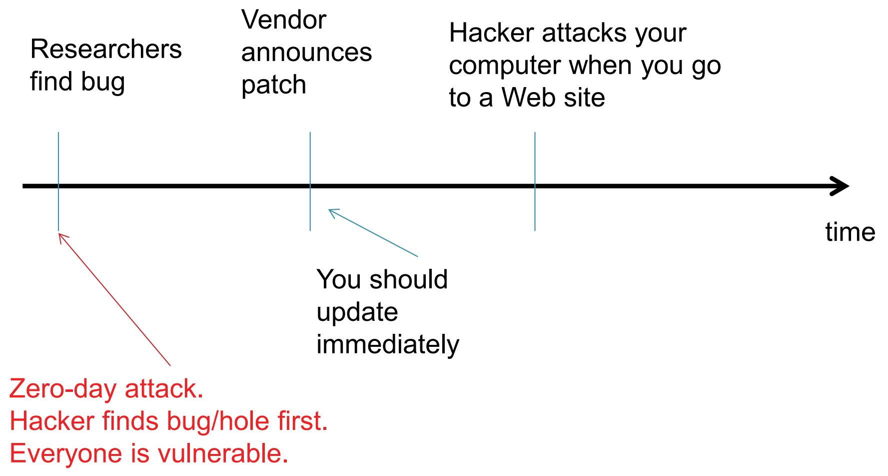


Figure 5.9

Zero-day attack. Attackers exploit a known bug or find their own and launch e-mails or even Web sites that can attack your computer. Because the bug has not yet been patched, it is easy for many computers to become infected.

Figure 5.9 shows a basic time line. A vendor or security researcher finds a problem and reports it to the software developer. The developer fixes the problem and releases a patch. Patches are released with varying levels of importance. Critical flaws that could allow an attacker to take over your machine are given the highest priority—particularly if the attack has already been seen "in the wild" or outside of a lab setting. You need to install these updates as soon as possible, and most computers should be set to automatically download and install critical updates when they are released.

This threat is magnified because attackers put scripts on the Internet that automatically scan for unprotected machines. These scripts make it possible for people with almost no computer skills to attack your system. Of course, there is still a risk that attackers can find flaws before software vendors find and patch them. These **zero-day attacks** could happen at any time, but they require considerably more work by the attackers and are likely to be aimed at specific targets. Still, you truly need to keep your system up to date to stop the known attacks. Many of these attacks are based on browsers and add-in software such as Java and Flash.

Intercepted Data

The Web and online content and services continue to be an increasing part of information systems and even daily life. Mobility and wireless connections are also gaining importance. Both of these trends lead to a potentially serious problem: Wireless data is relatively easy to intercept. Any device connected to the same network has the ability to monitor any packet sent on the network. The device is supposed to ignore packets not addressed to it, but it is relatively easy to tell it to capture all packets on the network.

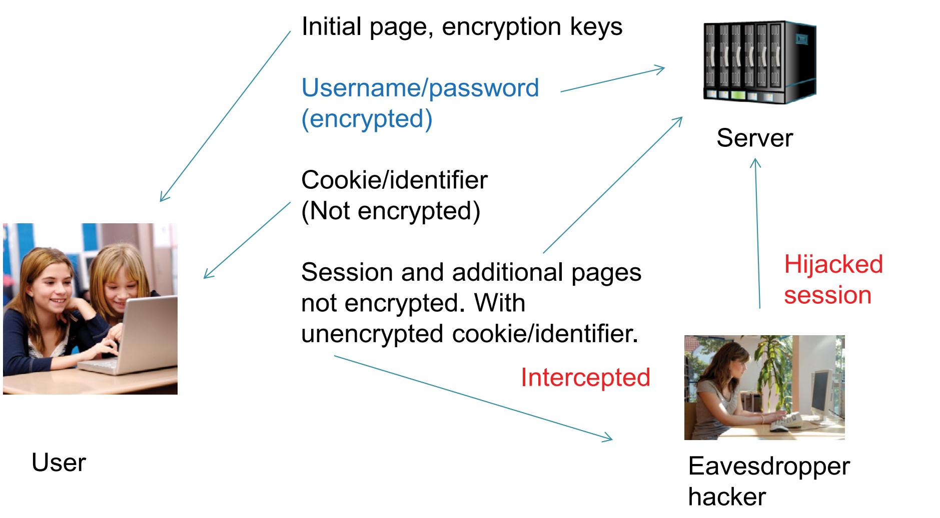


Figure 5.10

Intercept WiFi connections. Often, only the username and password are encrypted for many sites. But the session cookie that maintains the login is often unencrypted and it can be captured—allowing an eavesdropped to hijack the session and make changes as the user.

In late October 2010, Eric Butler released an add-on for the Firefox Web browser called *Firesheep* that makes it incredible easy for anyone to monitor WiFi traffic and hijack sessions from other users. Note, it is illegal to use another's computer account—no matter how easy it is to do. Figure 5.10 shows the basic process. A user signs into a Web service and the username and password are usually encrypted. The server generates a cookie and sends it to the user—so the user identity is maintained for the session without requiring a new login for every page. This cookie and subsequent activities are often unencrypted. The eavesdropper can grab the session cookie and hijack the session—making any changes to the user's account or Web contents.

Wireless transmissions are relatively open and broadcast over an area. The only way to protect the traffic is to encrypt everything. Web servers and browsers are designed to encrypt traffic, but most Web site designers tended to limit encryption to just the username and password pages. The feeling was that encryption slowed down the server, the browser, and the data transmissions. In the early days of the Web, these delays were measurable; so designers got in the habit of encrypting only what they felt were essential items. With faster computers and networks, sites will now be forced to encrypt all transmissions.

But, as a user of Web services, can you do anything while waiting for sites to turn on full encryption? You could simply avoid using any important services while connected to public wireless networks. Browsing Web sites to read the news is certainly not going to matter to anyone. Logging into a social network or e-mail site runs the risk of giving access to an eavesdropper—and with Firesheep, that eavesdropper could be anyone. The only other option is to sign up for a service that provides a **virtual private network (VPN)**. A VPN establishes an encrypted

Reality Bytes: Rogue IT Employees

Fortunately, most IT employees are extremely honest. They need to be honest because they have access to most of the company operations. But, that does not mean you should just ignore employees. Ronald Reagan's famous saying when negotiating a nuclear-arms reduction treaty with the Soviet Union seems to apply to many situations: "Trust but verify." In a different situation involving a Fortune 500 company, a rogue IT employee had "lost" 11 laptops over three years. A flag that should have raised questions earlier. Anyway, in 2008, a retailer in Pennsylvania had to hire a security consultant to investigate a problem after the Business Software Alliance (BSA) reported that the company might be using pirated software. The investigation found that the software was illegal, and that it was sold to the retailer by a company secretly owned and operated by one of its own IT employees. More digging found that the seven-year employee had been running a for-pay pornography site on the company's servers and that he had stolen 400 customer credit-card numbers from the retailer's Web site. And he was the only person who had the administrative passwords. The U.S. Secret Service and CERT provide a whitepaper that lists basic steps you can take to reduce threats from insiders. (http://www.cert.org/archive/pdf/CSG-V3.pdf) To recover the systems, the company sent the rogue employee on a long overnight flight to California, then used the five hours to reset every possible password and lock him out of the systems. When the flight landed, the COO met him at the airport and fired him on the spot. Although a background check might not have prevented the hiring of the rogue employee, it probably would have spotted is lie about having an MBA degree. Other people have suggested that his personality should have indicated some problems. One of the investigators said that "He was extremely confident, cocky and very dismissive of other people." Most good IT employees realize it is impossible to know everything, are willing to consult with other experts, and are helpful to employees.

Adapted from Tam Harbert, "Security Fail: When Trusted IT People Go Bad," *Computerworld*, January 18, 2011.

network from your computer (laptop) to the VPN server. No one can intercept the traffic between those two points. Companies often set up VPN services so workers can securely connect from home into the company network and operate as if they were on site. Several commercial companies provide VPN services to individuals for a monthly fee. If possible, you should test the VPN services before signing onto a long-term contract. You want to ensure that the company has fast and reliable connections and servers that are available whenever you need them. It takes several steps to install a VPN and it might interfere with some applications.

Computer Security Controls

What primary options are used to provide computer security? Transaction and accounting data is clearly valuable to a company and needs to be protected. Computer security systems need to protect against three general problems: (1) unauthorized disclosure of information, (2) unauthorized modification, and (3) unauthorized withholding of information. These three problems are sometimes referred to as: confidentiality, integrity, and accessibility, leading to the too-cute acronym CIA. As an example of the first problem, you would not want hackers to get access to your customers' credit card data. An example of the second problem would be employees modifying their payroll records to change their pay rates. The third problem is less obvious, but just as important. Imagine what would happen if you needed to look at the latest inventory to decide how much to reorder, but the computer refused to give you access. This problem is often referred to as **denial of service (DoS)** and is a difficult problem faced by Web sites.

User Identification

One of the primary difficulties with providing computer security lies in identifying the user. For years, the most common means of identifying computer users is through usernames and passwords—because this method is easy to program. The programmers simply set up a database of users that contain a username and password. No standards are needed and every system can be independent. More recently, interest in biometrics has been increasing; particularly the fingerprint readers installed on laptops; but the lack of standards has prevented widespread adoption of these technologies.

Passwords

Each user is given an account name and a password that are known only to the computer and the user. If someone correctly enters both the name and the password, the computer assumes it must be the user. This method is cheap, fast, and does not require too much effort by the user. However, there are problems. The biggest difficulty is that users are afraid of forgetting their password, so they choose words that are easy to remember. Unfortunately, passwords that are easy to remember tend to be obvious to other people. For instance, never use the words *password* or *secret* as a password. Similarly, do not use the names of relatives, pets, or celebrities. Most of these can be obtained by looking in a phone book, talking to someone you know, or browsing your Facebook page.. In fact, you should not use any actual words. Most people use only a few thousand words in typical conversation. The goal is to make it hard for someone to guess the password. You need to choose passwords from the largest possible set of characters and numbers. Two other rules about passwords: Change them often and do not use the same password for everything. Most systems have a method to enable you to change passwords. Some systems force users to change passwords on a regular basis, such as every 30 or 60 days.

One drawback to passwords is that you need too many of them. Everything from ATM cards to phone calls to computer accounts uses passwords or personal identification numbers (PINs). It is too risky to use the same password for every account, but it is difficult to remember several different passwords, especially if you choose random letters and numbers and change them often. With so many passwords, it is tempting to write them down, which defeats their purpose. This conflict is the main reason a new system is needed to identify users.

Passwords are not a perfect solution to identifying users. No matter how well they are chosen or how often they are changed, there is always a chance that someone could guess the password. Companies are moving to **two-factor authentication**, where users need a password and a second method of identification. Password generators described in the next section are sometimes used as the second method. .

Figure 5.11

Biometric devices. Several methods exist to identify a person based on biological characteristics. Common techniques include fingerprint, handprint readers, and retinal scanners. The iris scanner is a relatively useful technology since it requires only a camera and is noninvasive.

Password Generators

Password generators are small electronic cards that generate new passwords every minute. The same system is embedded on the main computer. When you want to log in, you simply enter the number on the card that you are carrying. Since the password is changed every minute, you do not have to worry about anyone guessing it or intercepting it. On the other hand, you have to carry around the card. You also have to enter a password when you log in to safeguard against loss or theft of the card. However, the password does not have to be changed constantly because the risks are lower. Banks and government agencies have been leading adopters of this technology for providing secure access by employees. The cards are relatively inexpensive, easy to configure, and can be revoked if they are lost or an employee leaves. The technology could become even more useful if it could be integrated into your cell phone. You cannot ask people to carry around dozens of security cards, so it makes more sense to integrate the security into a device they already carry. At this point in time, no one has built software to perform this task, but it would be relatively straightforward.

Biometrics

Biometrics is a field of study that attempts to identify people based on biological characteristics. The most promising devices are fingerprint and handprint readers. As shown in Figure 5.11, there are even devices that recognize the pattern of your iris (the colored ring surrounding the pupil of your eye). These systems work with a simple camera that can be installed cheaply. They are being tested now for identification at airports and in ATMs. The Canadian government is building a large-scale system to handle customs check-in for returning Canadian citizens.

As costs decline, the biggest drawback to biometric security devices is a lack of standards. You can use a fingerprint scanner to log into Windows, and the Windows ID can be used to get access to in-house systems. However, the biometric

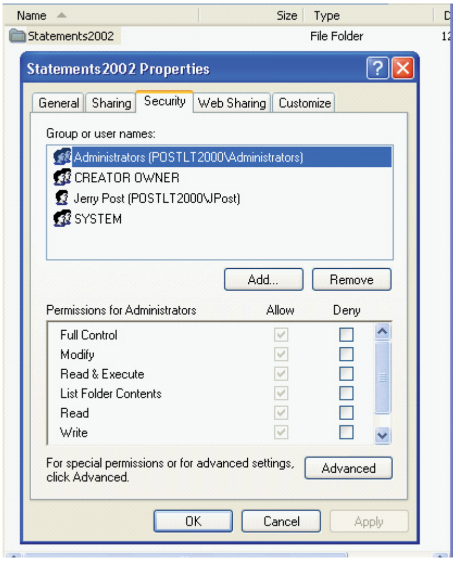


Figure 5.12

Access control. In Windows, right-click the folder or file to set its properties. Under the Security tab, you can set permissions to any person or group.

data is not used beyond the single computer, and there are no standards for transferring the data securely to other servers.

Biometric security devices have some important advantages. The user does not have to remember anything or carry keys around. They are reasonably accurate and difficult to fool by an unauthorized person. But the industry still needs standards so that the security information can be transferred securely and validated by the final server.

Some of the worrisome issues of biometrics have held back its adoption. Many people are concerned about privacy—the perceived ability of governments to track people if biometrics become widely adopted. Another concern is that to use biometrics, you must first register your information (fingerprint or iris scan) and have that data stored within the system. People worry that if someone steals this data, the thief could use it to impersonate anyone. The assumption is that it is easy to change passwords if they are stolen, but difficult to change your fingerprints. The fallacy to this argument is that the biometric data is never stored in raw form. Instead, a one-way hash is used that converts the raw data into a new, encrypted set of digital data. It is impossible to retrieve the raw data from the stored set. By using unique encoders each time the data is scanned, such as time stamps and fuzzy adjusters, it is possible to prevent these **replay attacks**, where an attacker captures data as it is entered and uses it on a different system or at a later time.

Access Control

As long as the computer can identify each user, you can control access to any piece of data. As manager of the marketing department, you could allow other managers to read the sales data but not change it. Similarly, as shown in Figure 5.12, the accounting department could allow managers to see the accounts payable data, but only the accounting department would be able to modify the data and write new checks. With a good security system, it is possible for the human resources manager to allow employees to look up work phone numbers in the corporate database but not to see salaries or other confidential information.

The common access controls available are read, write or modify, execute, and delete. With these security features, the owner of the information can give other users exactly the type of access they need. Windows and other operating systems support additional permissions for folders, so you can control exactly which files people can see, whether they can change permissions, or even deny specific tasks to individuals.

As a creator of data, it is your responsibility to set the appropriate access permissions. Today, most of your files will be shared through a Web site. You can set aside different directories for each group of users and assign permissions to each directory. To avoid accidents, you generally do not give anyone delete permissions. Your main choice is which users should be able to read the data, and which ones need to be able to change it. Of course, if multiple people have permission to change a document, you should set the document to track changes so you can see who made each change.

Administrator Access Rights

Virus, Spyware, and Phishing attacks present difficult problems in terms of security. These attack methods take over the permissions of the user. If you (the user) have high permissions, the attacking software can gain total control over your machine. One of the most common tricks is to install software on your computer that provides back-door access to an attacker. Because the attacking software has your permissions, you would generally not even know the software was installed. In early versions of personal computer operating systems, users were often made Administrators on the computer—giving you complete control over all features of the computer. This permission was generally needed to install new software and new hardware devices. However, it also gives attacking software total control over the computer. In most cases, users should not be included in the Administrators group. Microsoft Vista, and Windows 7 go a step further and ask you to verify the installation of new software. This approach was first proposed in 1987 (Post 1987), and is designed to notify you if an attacker is trying to install software or alter your machine. It can be a nuisance when you first configure a computer, but in daily use, the warning notices rarely appear. If they do, you should think carefully about whether you want to allow the software to alter your computer.

Single Sign-On and Lack of Standards

Figure 5.13 shows one partial solution to the large number of passwords is to use a **single sign-on** method. At least within a company, a central server handles all of the login tasks. For example, Microsoft's Active Directory uses a server based on **Kerberos** to authenticate users. This information is then provided to other servers throughout the company. Users log in once and the security server provides authentication to all of the authorized servers. At this point in time, it is not used for access to Internet sites.

It some ways, it would be nice if this feature could extend to Web sites across the Internet. Once you have logged into your machine, it could authenticate you to other computers on the Internet. This way, you would need only one password—or perhaps even a biometric scanner attached to your laptop. At this point in time,

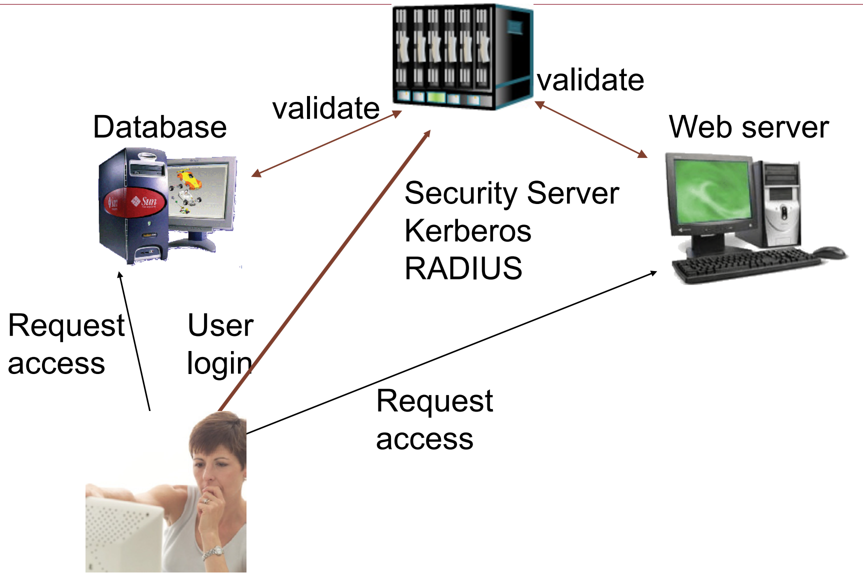


Figure 5.13

Single sign-on. A security server handles the initial login authentication. Any other servers or devices verify the user identification through a token that was issued by the security server.

the world is not even close to this solution. The problem: lack of standards. Few standards exist for collecting, storing, or sharing authentication data. Even if you buy a fingerprint reader for your laptop or cell phone, it cannot be used to verify your identity to external Web sites. So far, almost no work has been done on developing standards to support this level of authentication. The lack of standards is less important within a single company. Within a company, the MIS department has the authority to create and define its own standards, which gives it the ability to purchase and create software so that it can all be integrated. But, it will likely be several years before everyone sits down and agrees to the standards needed to share authentication information across the Internet.

Several vendors provide short-term solutions to manage passwords. Several store your Internet passwords in a file and then provide them to the server when you log in. Most browsers have a similar type of password caching mechanism. A couple of vendors provide USB drive-based solutions that work the same way. Passwords are cached in an encrypted file on the thumb drive and software delivers it to the Web site when you want to log in. Of course, if you lose the USB drive, you will lose your login information, so you need to be careful.

Encryption

How do you protect data when unknown people might be able to find it or intercept it? What additional benefits can be provided by encryption? Encryption is the foundation of many aspects of security. For example, encryption protects messages sent across the Internet and protects files stored on servers. Cryptography has been around for thousands of years, but computers have radically altered the types of codes available. One important

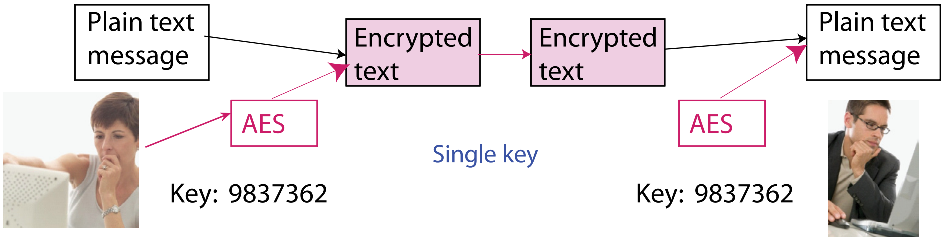


Figure 5.14

Single key encryption. Both the person who encrypts the message and the person who decrypts it use the same key. The systems are fast, but it is difficult to safely distribute the key.

feature to remember in terms of cryptography and computers is the concept of **brute force** attacks. If a hacker knows the algorithm method used to encrypt a message, it might be conceivable to have a computer test every possible key to decode the message. The essence of stopping a brute force attack is to have a key that is so long that it would take millions of years to try every combination. The problem is that computers get faster every year. So encryption technologies that were secure 20 years ago can be broken in hours today. Also recognize that a process that takes a million years could be completed in one year using a million computers. And, today, it is possible to find a million computers to use.

Encryption should be seriously considered for any communications that are sent between computers. Without encryption, it is relatively easy for unauthorized people to deliberately or accidentally read or change the messages. Encryption is available with many personal computer software packages. Almost all spreadsheets and word processors permit you to encrypt your file when you save it. To read it back, you have to enter the correct password. You also can find encryption packages on the Internet that will protect your e-mail messages.

Single Key

For many years, single-key encryption codes were the only systems available. Figure 5.14 shows the basic steps required to encrypt and decrypt a message with a single-key system. Both the sender and receiver have the software that handles the encryption and decryption. Both people also need to have the same key, which is the difficult part. How do you deliver a secret key to someone? And if you can deliver a secret key, you might as well send the message the same way.

On the other hand, single-key systems are fast. They can encrypt or decrypt a message with almost no delay. Since the late 1970s, most of the business world standardized on the Data Encryption Standard (DES). However, this system only supported keys of 56 bits, and by 2000, messages encrypted with DES were broken in under 24 hours by brute force attacks in various contests. Triple DES was popular for a while—essentially encrypting the message three times. But in 2001, the U.S. government chose a new method known as the **Advanced Encryption Standard (AES)** because it is fast and users have a choice of a key length of 128, 192, or 256 bits. Keep in mind that longer keys make the message more secure (harder to break by brute force) but increase the time it takes to encrypt and decrypt the message.

Technology Toolbox: Encryption

Problem: You need to send a file to someone without it being read by anyone else.
Tools: or single key encryption you can use Office and protect the file with a password. Dual-key encryption requires buying and installing certificates. You can also use BitLocker or other commercial programs to encrypt an entire drive or USB drive. The easiest way to secure a data file is to encrypt it by adding a password. With Office 2010, once the document has been created, use the menu: File/Info tab/Protect Document /Encrypt with Password (in the Permissions section). You will be prompted to enter a password and then enter it again to ensure you typed it correctly. The file is encrypted with AES when it is saved and the password is required to open and decrypt it. You can then e-mail the file to someone and not worry about it being intercepted. However, you must still find a way to tell the recipient the password. Obviously, you cannot send it by e-mail. A phone call would be better but not perfect. That is the heart of the problem with single-key encryption.

It is possible to purchase and install digital security certificates to automatically encrypt e-mail. After the certificates are installed, and the e-mail client (Outlook) is configured, e-mail and attachments can be encrypted by checking a single box. The problem is that everyone participating has to obtain and install security certificates and exchange public keys with everyone else. And the certificates usually expire after a year, so everyone has to repeat the process each year. The detailed steps are explained on Web sites that sell the personal security certificates.

A related issue is the need to encrypt an entire drive—either the main disk drive on a computer or a USB drive. Laptops and USB drives are particularly dangerous—every week, thousands of people lose both of these items. Laptops might seem secure—you need a password to log in—but it is relatively easy to remove the hard drive, put it in a case and read the entire drive by plugging the case into another computer. Several encryption programs can be purchased to encrypt the entire disk drive (or volume). Windows 7 (Ultimate and Enterprise) comes with the BitLocker Drive Encryption program. Other systems require you to purchase a commercial program. BitLocker is installed by opening the Control Panel and selecting the BitLocker Drive Encryption option. It works best if the computer has a Trusted Platform Module (TPM) chip, which is often installed in business-level laptops (especially Lenovo). The software requires additional configuration if the computer does not have a TPM—check the Internet for details. Basically, the encryption keys can be stored on a USB drive which must be inserted to startup the computer. The TPM is easier and safer because it stores the key on a hardware chip in the computer. BitLocker is also useful for encrypting USB drives, where a password is required to unlock the drive.

In a corporate environment that uses Active Directory and Group Policies, the BitLocker encryption keys can be stored centrally. The policies can even require that USB drives use BitLocker encryption or the system will be blocked from writing to them.

Quick Quiz:
1. 1. Why would a business want to use encryption?
2. When would it be useful to set up dual-key encryption for e-mail?
3. In a typical company, which drives should use drive-level encryption?

Reality Bytes: Don't be an Idiot

Despite the repeated press reports (and fake actions in Hollywood movies), computer security systems have improved considerably over the past few years. But, a weak link exists in every system: the component between the chair and the keyboard (you). It is easy to break into a system or steal money if you give away your password—or download and run software that gives control to hackers. In a 2010 scam, criminals called thousands of people and ran a basic scam. They claimed to provide free security checks and used a variety of "social engineering" scams to get passwords and account information. Microsoft paid for a survey of 7,000 computer users in the U.K., Ireland, the U.S., and Canada. In total, 15 percent of the respondents had received a phone call from the scammers. In Ireland, the rate was as high as 26 percent. Of those who had received the call, a whopping 22 percent followed the instructions and gave the scammers access to their computers. The victims lost $875 on average (but only $82 in Ireland). Perhaps they will consider it an educational fee. When a random person calls and asks for passwords, accounts, to run software or go to a specific Web site; just hang up the phone.

Adapted from Nathan Eddy, "Microsoft Survey Reveals Extent of Emerging Internet Phone Scam," *eWeek*, June 17, 2011.

Encryption is useful for almost any type of data that you need to protect. For example, you can save a Word document or Excel with a password, which encrypts the document with AES. If you want anyone else to open the document, you will have to provide the password. However, be sure to remember the password. Without it, you cannot retrieve any of the data. A few companies sell software that attempts to crack the Microsoft Office passwords. The process takes a long time if you use long, complex passwords, but keep in mind that these passwords might not be foolproof.

A second common use of encryption is useful for laptops. Windows (and other programs) include the ability to encrypt the entire hard drive. Without encryption, it is possible to remove the disk drive and connect it to another computer—which will be able to read all of the data on the drive. With encryption, the drive is tied to the specific computer, and the data cannot be read without logging into the specific drive. Since laptops are commonly lost or stolen, this level of encryption provides a useful method to protect the data from theft. The integration with Windows makes it relatively easy to install. On the other hand, encryption makes it more complicated to upgrade hard drives.

Public Key Infrastructure

Public key infrastructure (PKI) is a substantial leap in encryption technology. The method arose from a military-political question. Given a U.S. embassy in the middle of a foreign nation that can intercept all communications, how can a secret message be transmitted out of the embassy when there is no way to exchange a secret key? The answer was found by two mathematicians (Diffie and Hellman), and later refined into a system (and company) named after three other mathematicians (RSA: Rivest, Shamir, and Adleman). The solution is to create an encryption system that uses two keys: a **public key** and a **private key**.

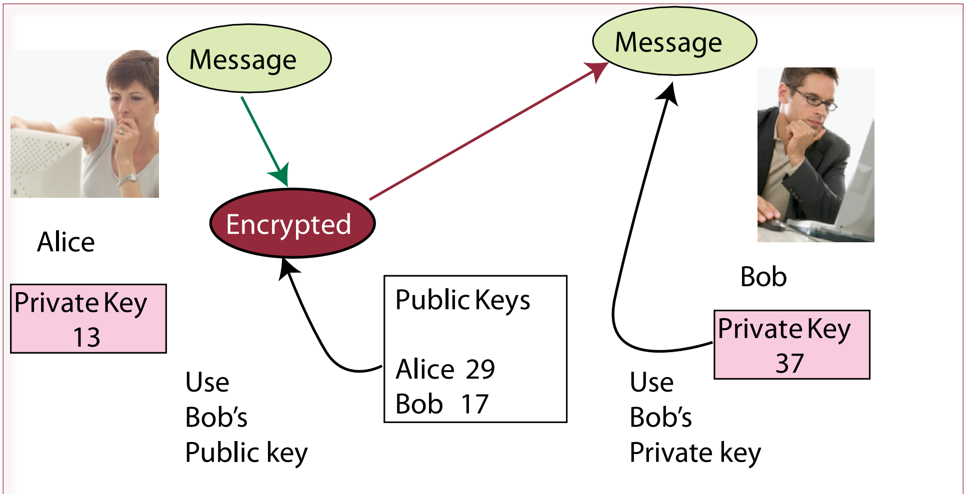


Figure 5.15

Dual-key encryption. Alice sends a message that only Bob can read. With a dual-key system, one key encrypts the message, the other decrypts it. Once Bob's public key is applied to the message, only Alice's private key will retrieve the message. Keys are usually very large prime numbers.

Dual Key Encryption

The essence of a dual-key system is that it takes both keys to encrypt and decrypt a message. Whichever key is used to encrypt the message, the other key must be used to decrypt it. Figure 5.15 illustrates the process. The beauty of the system is that anyone can be given your public key—in fact, this key can be published in a directory. Then, whenever someone wants to send you a secure message, he or she simply uses the RSA algorithm and your public key. At that point, the message is gibberish and can only be decrypted using your super-secret private key. No one can read or alter the message. However, someone could destroy it before it reaches you.

Today's Web browsers use this method to encrypt credit card transmissions. The Web server sends your browser a public key. The browser encrypts the content and sends it across the Internet. Only the Web server can decrypt the contents—using the private key. A similar system called **Pretty Good Privacy (PGP)** is available on the Internet to encrypt e-mail messages.

The one drawback to dual-key encryption systems is that they tend to be slow—particularly for long messages. One common solution is to use dual-key encryption to establish the identity of the parties and to exchange a one-time secret key to be used for the rest of the transmissions. The single-key system is fast and protects the transmitted data, and the initial dual-key system makes it possible to distribute the secret key without anyone stealing it.

Authentication

A second aspect of dual keys has even more uses. PKI can be used for **authentication**. Consider the case where Bob works for a bank, and she receives a message that claims to be from Alice, and it says to pay you $1 million. How does

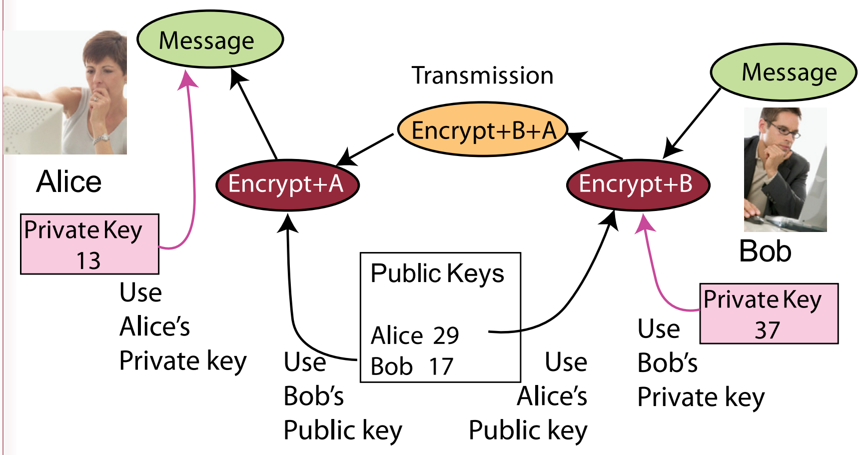


Figure 5.16

Dual-key encryption for message authentication. Alice sends a message to Bob at the bank. Using her private key ensures that the message must have come from her. Using Bob's public key prevents anyone else from reading or changing the message.

Bob know that the message is authentic and not forged by you? Consider the case where Alice want to pay you some money (but only $100).

Figure 5.16 shows the answer. To make sure that only Bob can read the message (and that no one else can modify it), Alice encrypts it with her public key. To ensure that the message is authentic, Alice also encrypts it with her private key. Remember that the keys always work in pairs. When Bob receives the message, she uses Alice's public key and her private key to decrypt it. If the message is decrypted correctly, then it was not modified in transit, and it could only have come from Alice. This process is used to create **digital signatures**. In 2000, the federal government passed a law declaring digital signatures to carry the same legal authority as a traditional signature for legal purposes.

Certificate Authorities

The proper name for dual-key encryption is public key infrastructure (PKI). Why is the word *infrastructure* so important? Think about how a hacker might attack the system in Figure 5.16. What if Alice did not know much about technology and encryption? So, posing as Alice, you create a private key and publish the public key in a directory under Alice's name. Then you send your e-mail message to the bank pretending to be Alice, using "her" public key and asking the bank to pay you $1 million. The message decrypts fine, and Bob believes the message is legitimate. Similar problems can arise by impersonating the bank.

To make the PKI system work, it is critical that the directory of public keys accurately represent the people indicated. So, some organization needs to be in charge of the public directory, and people who wish to use it need to verify their identity before registering a public key. At the moment, several commercial companies operate as **certificate authorities** and sell digital encryption certificates to anyone. Almost no oversight or regulation exists in the industry. At one level, the browser developers (Microsoft) control which companies get listed as trusted root providers in the browser, but there is no governmental regulation. The U.S. mili-

Reality Bytes: Microsoft gets Binged

Just to show that insider theft can happen in any company, Microsoft sued a former Bing toolbar promotions director for allegedly stealing $460,000 from the company and trying to walk away with another $1.5 million. Microsoft claims that Robert D. Curry set up a fake company (Blu Games) and submitted fake invoices for services it never performed. Microsoft claimed that Curry created false documents and even forged his manager's signature. As promotions director, his job was to convince companies to encourage people to download the Bing toolbar to increase the use of the Bing search engine. Microsoft spotted the problem only after Curry convinced the finance department to increase the amount of funds for the project to $3.7 million. He was then going to transfer the $1.5 million to his company through a legitimate vendor (Pentad). But, the size of the transaction apparently caught the eye of internal auditors.

Adapted from Gregg Keizer, "Microsoft Claims Employee Stole $460,000 from the Company," *Computerworld*, January 27, 2011.

tary (and probably others) does run its own certificate servers but those are used only within the military networks.

These public companies, including Verisign and GoDaddy sell **digital certificates** that verify the identity of the person and generate the public/private key pairs. Companies and individuals can purchase these certificates, and you are supposed to verify your identity before receiving the certificate. However, in 2001, Verisign announced that it accidentally issued a digital certificate to an imposter who claimed to be from Microsoft. Eventually Verisign caught the mistake and invalidated the certificate, but the incident points out that the process is far from foolproof. The troubling point is that for the PKI system to work, the certificates and keys must be controlled by a trusted organization.

A handful of public CA firms exist today—leading to some competition in price, but there is still no oversight. In fact, you can easily install a server and generate your own security certificates. These certificates are useful for your own employees. Companies can install them on employee computers and use the certificate to identify a user instead of relying on passwords. Generating your own certificates reduces your costs. However, they are not useful for e-commerce, because your company will not be recognized by the customer's browser. You can look at your Web browser options to see the list of Trusted Root Certification Authorities. This list represents CAs that are automatically recognized by your browser. A certificate issued by anyone else creates a warning message.

Encryption is used in many areas in computer security, but it is not the only factor in security. It is important to protect data during transmission, and it is useful to encrypt sensitive data on disk drives. But, decryption keys need to be stored someplace, so attackers often target those storage locations. So, the security threat simply shifts to a different level. Any security system needs to incorporate multiple levels of protection. Encryption is one level of security that is designed to solve specific problems.

Encryption also presents issues to society—which are covered in more detail in Chapter 14. For now, note that encryption is available to everyone: individuals, businesses, criminals, spies, and terrorists. Consequently, many government

Reality Bytes: Hacker Arrests

The hacker group "Anonymous" obtained huge publicity during the WikiLeaks discussions of late 2010. The group encouraged people to download its software so their computers could be used to attack business and governmental sites. In mid-2011, the Spanish police arrested three individuals claimed to be senior members of the Anonymous group within Spain. A computer found at the home of one of the individuals was alleged to have been used to launch attacks against many Web sites. Anonymous responded by initiating a denial of service attack against Spanish police computers, and denying that the three arrested were part of the group; or that Anonymous was even a group. Earlier, Dutch police arrested two teenagers in December 2010; and the UK police arrest five males in early 2011. In the U.S. the FBI searched homes of several alleged members of Anonymous, but no arrests were made. Turkish police arrested 32 people in early June 2011. In early June 2011, NATO declared that Anonymous and similar groups were a threat to international security.

Adapted from Cassell Bryan-Low, "Spain Arrests Three in Hacker Crackdown," *The Wall Street Journal*, June 10, 2011; and Ben Rooney, "Turkey Arrests 32 in Hacker Swoop," *The Wall Street Journal*, June 13, 2011.

agencies want methods to decrypt messages. The U.S. government has proposed several encryption methods that contain back-door keys that would allow agents to decrypt messages easily.

Additional Security Measures

What non-computer-based tools can be used to provide additional security? A fundamental issue in computer security is that logical controls are never enough to protect the computer. For example, anyone who has physical access to the computer can either circumvent the security controls or destroy the data. Besides, many employees have extended access to the data and applications. To be safe, you need to implement some standard business policies. You also need to train users periodically to warn them about new attacks and remind them to never give their passwords to anyone else.

Audits

Accountants have long known that to maintain security over data, it is necessary to perform audits. There are too many ways for unscrupulous people to make changes to stored information. Audits are used to locate mistakes and to prevent fraud. Existing criminology practice states that in many cases, the threat of getting caught (by an audit) will convince most people to be more careful and to avoid fraudulent behavior. The same principles extend to security audits. By monitoring computer activity, auditing financial records, and periodically checking to see whether everyone is obeying security regulations, users are encouraged to follow the security guidelines of the company.

Of course, audits cost money and they interfere with the daily operations of the firm. As a result, it is important to schedule audits carefully and to keep an eye on the costs as well as the potential benefits. Several professional organizations (such as the EDP Auditors Association) can help security employees learn more about the latest technologies and teach them what to look for in audits. The

Reality Bytes: Find the Weakest Point

A common problem in security is that you can strongly protect one point, only to lose because the system is vulnerable at a different location. Security certificates are strong protection for transmitting data on the Internet. The encrypted traffic is extremely difficult to break. But, in 2011, someone, possibly in Iran, was able to obtain server security certificates from Comodo in the names of Google, Microsoft, Skype, and Yahoo. Melih Abdulhayoglu, the CEO and founder of security company Comodo noted that "One of the origins of the attack that we experienced is from Iran. What is being obtained would enable the perpetrator to intercept Web-based email/communication and the only way this could be done is if the perpetrator had access to the country's DNS infrastructure (and we believe it might be the case here)." Fortunately, Comodo identified the attack and revoked the bogus certificates. Browser vendors (Google, Microsoft, and Mozilla) quickly followed by tagging the certificates as invalid within their browsers. The ability to withdraw and flag certificates is an important Web security feature. But it still requires that certificate authorities identify problems and react quickly.

Adapted from Gregg Keizer, "Firm Points Finger at Iran for SSL Certificate Theft," *Computerworld*, March 23, 2011.

American Institute of Certified Public Accountants (AICPA) also provides standards and audit guidelines that are useful at combating fraud.

Physical Access

Because it is so difficult to provide logical security to a computer, other mechanisms have been developed. Many of them rely on controlling physical access to the computer. For instance, computers and terminals should be kept in controlled areas. They must certainly be kept away from visitors and delivery people. Many types of locks and keys can be used to protect terminals and personal computers. Similarly, all documents should be controlled. Paper copies of important reports should be shredded. All financial data is routinely audited by both internal and external auditors. Sometimes hidden control data is used to make sure procedures are followed.

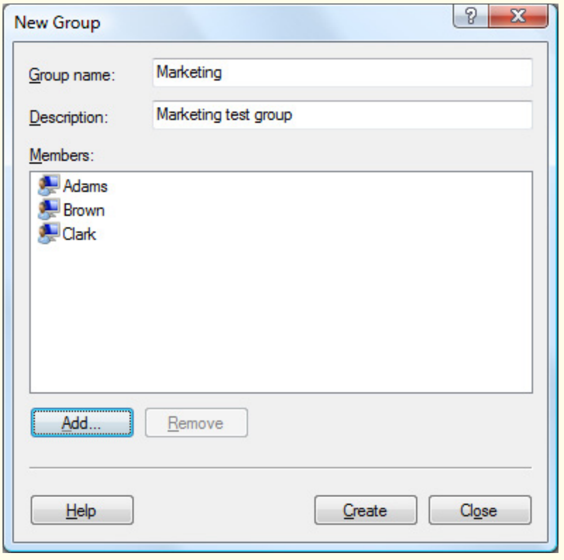
Monitoring

Another effective security provision is to monitor access to all of the data. Most computers can track every change to every file. They can keep a log of who accesses each file. They track every time someone incorrectly enters a password. An audit trail of every file change can be provided to management. That means it is possible to find out who changed the salary data, what time it was changed, and from which terminal.

Remember that every device connected to the Internet is given a unique number as an address. Every Web site that you visit can track this number. In some cases, you can only be identified down to the company you work for, but in many situations, companies can monitor exactly what each machine is doing at any time. Additional software can be installed on computers to provide even more detail—including storing all keystrokes.

Technology Toolbox: Assigning Security Permissions

Problem: You need to share some files with members of the marketing department.
Tools: Windows has the ability to set detailed security permissions on folders and files.



In a student lab, you might not have permissions to create folders and set file permissions. Some versions of Vista might not support detailed security options. Browse to a location where you want to put a shared folder. Create the new folder.

In a business setting, the users and groups have probably already been created by the network administrator. If you need to create groups and users, use the Start menu/All Programs/Administrative Tools/Computer Management. If you do not see the administrative tools, you need to enable it by setting the properties of the main taskbar, or use Start: compmgmt.msc /s. Right-click the Users icon and select New User. Make up a username and password for a user. Repeat this until you have three sample users. (If the users are already defined on the network, you can skip this step.) Right-click the Groups icon and select New Group. Name it Marketing and provide a description. Click the Add button and enter the usernames of the three users you just created.

Return to your folder and right-click the folder icon and select the Sharing and Security option. Click the option to share the folder and name it Marketing. Click the Permissions button and Remove the Everyone group. Add the new Marketing group and assign Read permission. Click the Apply button, then click the Security tab. Click the Add button and enter the Marketing group so they have read access. Click the Add button and enter the name of one of the users. Give this person Modify (and Write) permissions. This user will be able to read and change files stored in this folder—the others will only be able to read them. Log on as one of the new users and testing the file permissions. Note, if you are familiar with command-line commands (DOS), you can use the runas command without logging off. When you are finished, remove the Marketing group and users using the Computer Management tool.

Quick Quiz:
1. Why is it important to define groups of users?
2. Why is it important to delete this test group and users when you are finished?

- Audits
- Monitoring
- Background checks:

http://www.lexisnexis.com/risk

(bought ChoicePoint)

http://www.knowx.com/

(also lexis nexis)

http://www.casebreakers.com/

http://www.publicdata.com/

Figure 5.17

Employee background checks are important. For a fee, several websites help small businesses perform basic background checks to verify SSNs and check public criminal records.

Hiring and Employee Evaluation

Because insiders raise the greatest security issues, it makes sense to be careful when you hire employees. Employers should always check candidates' references. In more extreme situations, employers can check employee backgrounds for criminal records. There are several instances of disgruntled employees causing security problems. In many cases, the best security solution is to establish close relationships with your employees and encourage teamwork. Employees who work closely together can defuse potential problems and informally monitor the work of other employees. Figure 5.17 notes that several Web sites will search public records to perform basic background checks for small businesses. Validating social security numbers is an important step for many U.S. businesses.

Computer Forensics

How do you prove the allegations in a computer crime? Sometimes, stopping computer attacks is not good enough. You want to catch the crooks or attackers and have them charged with the appropriate crime. The problem is that you have to be extremely careful when you collect evidence that will be used in a criminal case. In particular, the investigator has to be able to guarantee the authenticity of the evidence from the moment it is collected to when it is presented in court. This process can be tricky with digital evidence. It is not a task for amateurs. You have to bring in a professional investigator to handle the evidence correctly. Of course, few police departments have people trained in computer crime, and they are probably busy chasing murderers and drug dealers.

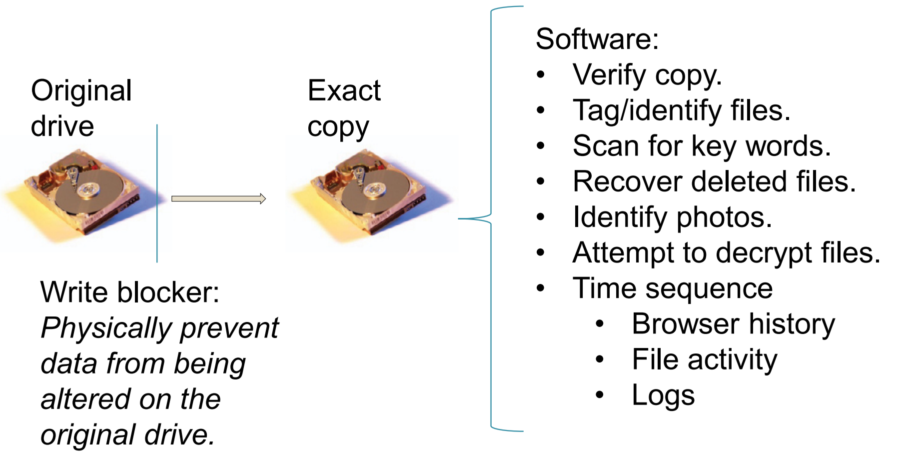


Figure 5.18

Computer forensics. Careful steps must be followed to protect the integrity of the evidence and the chain back to the alleged criminal. Once the data is copied, special software is used to recover deleted files and search for keywords, images, and activity sequences. A human investigator is still needed to interpret the results and direct the search.

Some private companies help with investigations, but make sure you contact your lawyers and the prosecuting attorneys early in the process. Several technical companies exist to help examine computer evidence, such as recovering data from hard drives and decrypting files. Throughout the entire process, you have to keep good records. Most actions have to be logged; and be sure to record the date, time, and people involved. Also, remember that computer logs and backup tapes often get recycled after a certain time, so be sure to maintain secure copies. Figure 5.18 shows some of the capabilities of commercially available forensic hardware and software. Typically, a drive is cloned with a special device to prevent data from being altered on the original drive. Copies of the cloned drive are then created and used for searching. Special software recovers deleted files and performs keyword searches. Photos are often important and are organized by the software. Some software can highlight time sequences based on file dates, computer logs, and the browser history. Increasingly, the challenge lies in the vast amount of data stored on computers. Computerized searches are required to cover the amount of data, but a human investigator is needed to identify keywords and look through potential matches. Even if the computer can find photo and movie files, the computer is not very good at finding objects or classifying images in photos or video. The task of examining computer files is time consuming and highly detailed. But, several job openings are available for specialists trained in computer forensics.

E-Commerce and Cloud Computing Security Issues

What special security problems arise in e-commerce? E-commerce and cloud computing use the same security technologies available to any business. However, some aspects of online businesses are more sensitive and require more careful security planning. These issues are highlighted in this section, with

1. Install and maintain a firewall configuration to protect cardholder data.
2. Do not use vendor-supplied defaults for passwords.
3. Protect stored cardholder data.
4. Encrypt transmission of cardholder data across open, public networks.
5. Use and regularly update anti-virus software.
6. Develop and maintain secure systems and applications.
7. Restrict access to cardholder data by business need to know.
8. Assign a unique id to each person with computer access.
9. Restrict physical access to cardholder data.
10. Track and monitor all access to network resources and cardholder data.
11. Regularly test security systems and processes.
12. Maintain a policy that addresses information security.

Figure 5.19

Payment card industry security rules. Any merchant or business that handles credit card data must agree to abide by these rules. Source: https://www.pcisecuritystandards.org

a discussion of the common solutions. The earlier sections already covered the issues of data transmission and the importance of encryption. Most Web sites use dual-key encryption through a system known as **secure sockets layer (SSL)**. Online Web services should use SSL for all communications. Servers also need to be protected against direct attacks. One layer of protection is provided by segmenting the network holding the servers using firewalls. Additionally, intrusion detection and prevention methods can be used to monitor for various attacks. One other serious problem is denial of service attacks—which are difficult to solve for an individual company.

Theft of Data from Servers

Because of the powerful encryption systems available, interception of transmissions is a relatively minor problem—as long as you use the encryption techniques. Instead, the servers connected to the Internet have become tempting targets. Several incidents have been reported of hackers stealing millions of records of customer credit card data from e-commerce firms. While credit laws protect consumers, the loss of a credit card is still painful and time consuming. In addition, the e-commerce firm faces liability issues if it did not adequately secure the data.

Securing servers uses the same technologies as any computer system: (1) make sure the latest operating system patches have been applied, (2) set access control rights to the smallest number of people possible, (3) encrypt the sensitive data, (4) hire trusted employees, and (5) monitor access to the sensitive data. A sixth step (firewalls) is explained in a later section. Figure 5.19 shows the primary categories that are required by the major credit card companies. Merchant banks and the card companies require vendors to agree to these conditions or they will not allow you to handle credit card data. They also require you to pay for periodic tests by an outside approved company. No support or negotiation is provided for any of the terms. The card companies have effectively become a monopoly in their attempts to push security (and blame) onto the merchants. Consequently, it is increasingly difficult for small merchants to handle their own credit-card processing. Instead, anything less than huge firms should use payment mechanisms through a third-

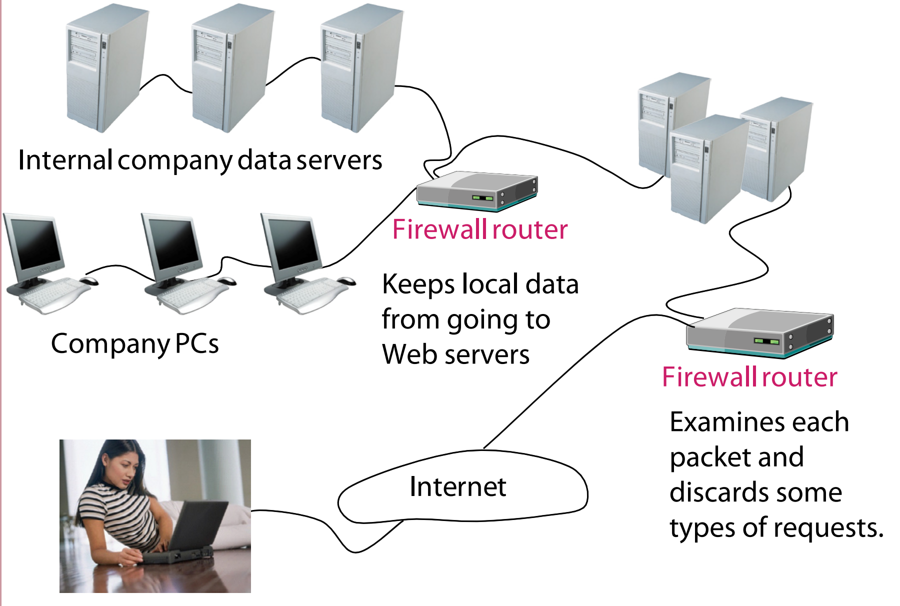


Figure 5.20

Firewalls. Firewalls are packet analyzers that are used to keep local data from moving to the Internet and to limit the actions allowed in from the Internet. Firewalls examine each packet of data on the network and block certain types to limit the interaction of the company network with the Internet.

party, such as PayPal, Google, FirstData, or even Amazon. These firms all charge fees for handling the credit cards, but you avoid most of the risk and the costs of maintaining detailed security systems.

Firewalls

The Internet and e-commerce add some complications to protecting company data. You need to give customers access to some important company data to provide the best e-commerce site. For example, customers like to know if an item is in stock before they place an order. To offer this service, you need to connect your Web server to your company inventory system. But any time you open a connection from the Internet to your company data, you have to be extremely careful to control that interaction. Security access controls and database security controls are two important provisions.

Beyond access control, simply connecting your company computers to the Internet could cause problems within the network itself. You do not want company network traffic being sent to the Internet, and you do not want outsiders to be able to see your internal computers—giving them the chance to try and break into your servers. Figure 5.20 shows how firewalls are used to isolate sections of the network. **Firewalls** are essentially routers that examine each packet of network data passing through them and block certain types to limit the interaction of the company network with the Internet. The Internet protocols were designed as an open network to transport many types of data and to enable computers to connect in many different ways. For example, servers have logical ports on which they listen for re-

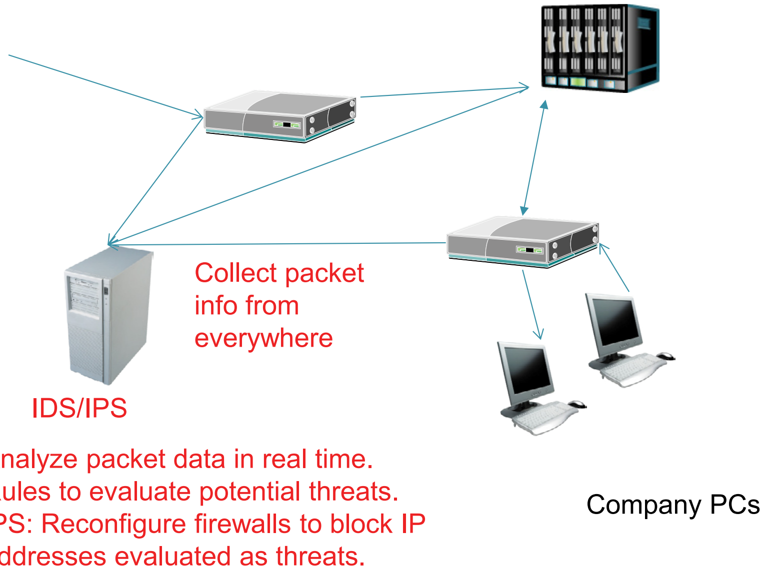


Figure 5.21

Intrusion detection and prevention. The IDS monitors packets and logs from routers, servers, and special network devices. It has rules to recognize certain attacks and can monitor for changes in traffic patterns. An IPS can shut off a network connection if it detects a threat.

quests. Since only a few of these ports are used for common Internet activities, the firewall is configured to block all of the other ports to prevent outsiders from finding a back way into one of your servers.

Firewalls are also used to segment your network. Internet traffic can be controlled based on a set of rules. These rules can include the IP source and destination address, the incoming and outgoing ports, and the protocol or primary purpose of the packet. By adjusting the rules, security experts can force Internet traffic to specific servers and prevent that traffic from going anywhere else on the network. It is common practice to put Web servers in a special section of the network that only allows certain traffic into and from the servers.

Intrusion Detection and Prevention

Monitoring the networks and servers is an important step in providing a secure system. If nothing else, you need to know if someone has broken into your servers—preferably before the police knock on the door and tell you. As shown in Figure 5.21, an **intrusion detection system (IDS)** is a combination of hardware and software that continuously monitors the network traffic. The hardware is similar to that used in a firewall, but instead of blocking the packets, it performs a more complex analysis. The systems use a set of rules to monitor all Internet traffic and search for patterns. For instance, a common attack often begins with a sweep of a target's network to look for open ports. The IDS observes this repeated scanning, blocks the requests, identifies the source, and sends a warning to the security manager. An IDS is an effective monitoring tool, but the cheaper ones tend to generate too many false warnings.

Reality Bytes: RSA Hack from the Top

RSA Security, a subsidiary of EMC, is one of the big players in computer security. The company was one of the first to develop and sell dual-key encryption and SSL certificates. When the original patents expired and competitors undercut its prices, the company turned to other technologies and services. In particular, the company is known for its SecurID, which is a small device that generates a new password key every minute. The keys are synchronized to the server, so the passwords are only good for one-time use and change constantly. The process makes it relatively difficult for anyone to attack a login to a protected server. So, instead of attacking the protected computers, in 2011, hackers went after RSA itself. Apparently, someone was able to breach the security and obtain access to the underlying keys. These attackers then used the data to break into computers at defense contractor Lockheed Martin. Not long after, RSA issued millions of replacement security tokens for virtually every customer.

Adapted from Siobhan Gorman and Shara Tibken, "Security 'Tokens' Take Hit," *The Wall Street Journal*, June 7, 2011.

An **intrusion prevention system (IPS)** begins with an IDS but adds the ability to shut down a network connection that has been identified as a threat. For instance, if the system detects a repeated scan from a specific IP address, it will set a rule in the main Internet router and tell it to discard any incoming packets from that IP address. Typically these blocking rules are set in place for a specific amount of time and then released after the immediate danger has passed.

The main problem with and IDS and an IPS is that servers today are constantly under attack. An IDS will identify almost continuous scans of various types from around the world. An IDS that triggers alerts for every one of these attacks would constantly be sending out warnings. Humans would be overloaded and ignore the warnings. Using an IPS to block out some of the obvious scans is a partial answer. But, remember that many organizations use network address translation—which means IP addresses are shared and reused. So, if a crazed lunatic from a large university uses a PC to scan outside servers, the IPS on that server could respond by blocking the server for a large chunk of users at that university. The problem with an IDS and IPS is that it is difficult to draw this line between identifying attacks and allowing people to use the servers.

Denial of Service

Denial-of-service attacks have gained importance in the last few years. The essence of an e-business site is the ability to reach customers 24 hours a day. If someone floods the site with meaningless traffic, then no one can use the service and the company may go out of business. Several variations of DoS have been used in the past couple of years, sometimes dragging down large chunks of the Internet at one time. Most of the techniques take advantage of flaws in the Internet protocols or in their implementation on a particular type of server. Figure 5.22 illustrates the process. A hacker breaks into some weakly protected computers and loads a special program that is hidden. On a signal, the machines all send requests to the targeted server. With some known Internet design flaws, these messages can

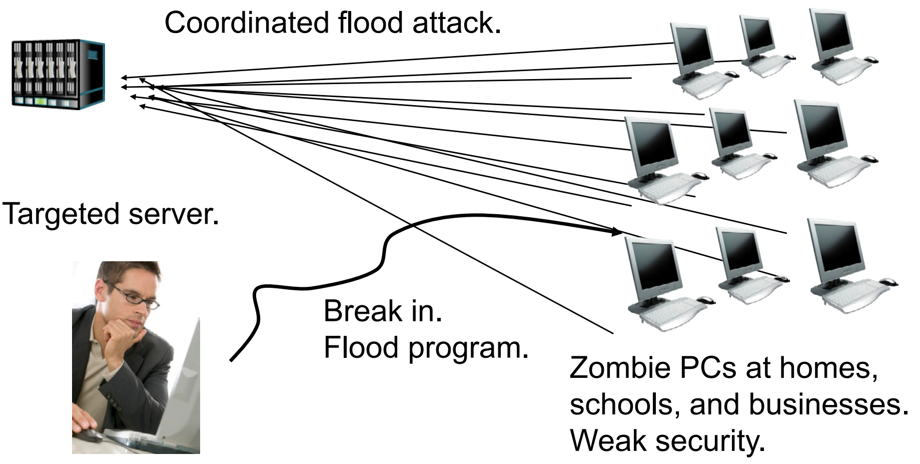


Figure 5.22

Denial of service attack. A bored hacker first breaks into weakly protected home and school systems and loads a hidden program on thousands of machines. At a signal, all of the zombie machines send messages to the server, preventing everyone else from using it.

be multiplied so that a few thousand messages become millions and bog down the server. This type of attack is hard to trace to the original source unless investigators find monitor logs on the zombie machines. Several Internet sites provide simplified instructions on how to perform these attacks, so even weak hackers or "script kiddies" can create havoc.

In many cases, a hacker has to break into thousands of computers to turn them into zombies that can be used for DoS attacks. Some attackers use scanning tools to search for PCs that lack critical updates and then attack individual computers. These attackers then install their software and link the computers to a central server that sends control messages to the zombies. The attackers can then lease these botnets to other hackers. An interesting twist to this process arose in 2010 and 2011 during the release of war data and an investigation of Julian Assange, the founder of Wikileaks. A hacking group (Anonymous) decided to use their botnet to attack Web sites of people and organizations that were critical of Wikileaks. They also decided to expand the size of their botnet by letting people volunteer to have their computers become zombies. Of course, they did not use those terms, but apparently, some people did volunteer. Voluntarily adding your computer to a botnet conducting illegal activity is a really bad idea.

Stopping a DoS attack on your servers can be exceedingly difficult. Most companies will not have the resources to deal with the attack. The goal of DoS is to flood the network and servers with activity. One answer would be to add servers or network capacity to handle the load. One possible solution is to pay for cloud services such as Amazon's EC2 which spreads the processing across multiple servers in many locations and has multiple Internet connections around the globe. But, servers and bandwidth cost money, and the flood attacks could dramatically increase these costs.

Reality Bytes: Anything on a Network has Security Risks

In April 2011, Sony realized that someone had hacked its game network and taken complete control over the server. The network was used to run the PlayStation video-game service for more than 75 million customers. Sony had to take the entire system offline and rebuild many of the components. It took almost two months to restart the network. Later, Sony found attacks on a second network. Nintendo also found attacks against its game network. Many early networks were built without security as a primary component. Taking security on as an afterthought often causes problems. In June, Sega confirmed that its gaming network had also been attacked and that almost 1.3 million people lost their personal information. However, the Sega personal information was mostly limited to name, birthday, and e-mail addresses. The company uses external credit card processors to handle payments and does not store any financial data on its own servers.

Adapted from Ian Sherr, "Sony Shuts Down PlayStation Network Indefinitely," *The Wall Street Journal*, April 25, 2011; and Daisuke Wakabayashi, "Sega Confirms Cyberattack," *The Wall Street Journal*, June 19, 2011.

Occasionally, researchers and Internet-based companies will call on people to find a way to reduce the threat from DoS attacks. For a while, it was suggested that ISPs should be responsible for their clients. In a way, the imposition of data caps by ISPs is a response to this threat. If a client computer is spewing huge amounts of data—it is likely that this data is bad, either as spam or DoS attacks. The ISP should be able to recognize these offenders and shut them down. Of course, ISPs are reluctant to shut down paying customers; however, they are finding it easier to bill them more money for excessive use. In effect, these actions push the responsibility back to the owner of the computers. Microsoft helps users a little by embedding tools into Windows to monitor from some known highly-active spyware and botnet tools. In the end, it makes sense to use economics to encourage people to monitor their own computers.

Privacy

If you have to track everyone's computer use to improve security, what happens to privacy? Computer security is a complex topic. One of its most challenging aspects is that many of the tools available to improve security can also reduce individual privacy. For example, a single sign-on system used across the country could be used to track people through their purchases, when and where they used a computer, when they passed through toll booths or boarded planes, or almost anything else. Even without single sign-on, the security systems enable companies to track detailed usage by employees and customers.

These issues are explored in detail in Chapter 14. For now, you need to remember that many proposed security controls scare even honest people—because of the loss of privacy. As a businessperson, you must be aware of these problems and establish policies to minimize the effects and keep customers happy.

Summary

Companies have to trust employees, consultants, and business partners, but this group presents the greatest security threats. To maintain secure systems, companies often perform background checks on employees, separate tasks so multiple people can observe the work of others, and monitor financial transactions. Natural disasters are a threat to the physical assets, but their business damage can be minimized by having continuous backups in different locations. Cloud computing makes these facilities available even to small companies. The Internet provides more avenues of attack for outsiders—particularly through phishing schemes and attacks on unpatched systems. The best defenses are to install all current operating system patches, to assign access rights carefully, and to monitor the computer usage with an intrusion detection system. However, denial-of-service attacks are particularly hard to prevent.

Encryption protects data during transmission. It is particularly useful for sending credit card data over the Internet. It can also be used to provide digital signatures that authenticate users to validate the source of messages. If computer crimes are detected, the law requires careful collection and analysis of the data using validated computer forensic tools. Experienced experts are generally required to conduct these investigations.

A Manager's View

Computer security is a critical issue for any company. For Web-based businesses, careful controls and continual vigilance are mandatory. Information systems have many potential weaknesses and threats. But overall, electronic security can be stronger than any other form—if it is maintained by experts. Encryption is a key component in securing systems, communications, and protecting privacy. The drawback to security is that it imposes limits on employees and customers. Some tasks become more difficult and some loss of privacy occurs. To protect corporate and personal data, we have to be able to trust the people who collect the data.

Key Words

Advanced Encryption Standard (AES)
Application service providers (ASPs)
Authentication
Biometrics
brute force
certificate authorities
cold site
denial of service (DoS)
digital certificates
digital signatures
Firewalls
hot site
intrusion detection system (IDS)
intrusion prevention system (IPS)
Kerberos
malware
phishing
Pretty Good Privacy (PGP)
private key
public key
replay attacks
script kiddie
secure sockets layer (SSL)
single sign-on
social engineering
spyware
two-factor authentication
virtual private network (VPN)
virus
zero-day attacks

Web Site References

Computer Crime	
CERT	www.cert.org
Computer Crime Research Center	www.crime-research.org
Computer Security Institute	www.gocsi.com
FBI: Internet Crime Complaint	www.ic3.gov
Interpol	www.interpol.int/Public/TechnologyCrime
US CERT	www.us-cert.gov
National Security Agency	www.nsa.gov
Department of Justice/cyber crime	www.cybercrime.gov

Review Questions

1. What are the primary threats to information processed by computers?
2. How do viruses spread over the Internet? How do you stop them?
3. Why is data backup the most important aspect of security?
4. How do you protect yourself from false Web sites?
5. Why is it important to ensure updates and patches are installed soon after they are released?
6. What methods are available to identify computer users?
7. What are access controls and how are they used to protect information?
8. What are the advantages and disadvantages of dual-key encryption compared to single-key encryption?

9. How can dual-key encryption be used to authenticate a message?
10. Why are certificate authorities so important in a public key infrastructure?
11. Why do we not have a better system to identify users of Web sites?
12. What threat are audits trying to protect against?
13. If you wish to investigate a computer attack, what is the most important rule you need to follow?
14. What are the main issues in protecting e-commerce Web sites?
15. Why are wireless transmissions more of a security problem than wired systems?
16. What is a denial-of-service attack? Why is it so important in e-commerce? Why is it so difficult to prevent?
17. What is a firewall and how does it protect a company from Internet attacks?
18. How does an intrusion detection system work?

Exercises

1. Run Windows update on your computer and select the custom option. How many updates are available? List them. Do the same for Office update.
2. Review newspapers, magazines, and Web sites and find one case of an actual security problem, such as theft of data. If possible, identify the value of any losses and whether the criminal was caught. Summarize steps that could have been taken to prevent the incident.
3. Find at least two biometric login devices and their prices.
4. Research the current access control methods provided by your favorite social network site. Briefly describe how you would assign permissions to two sets of data to two groups of people. Group A can see the first set of items but not the second, and group B can see the second set but not the first.
5. Research the status of password-crackers. What length of password can be broken in a reasonable time (say less than a month)?
6. Assume you are running a small business that needs to hire employees. Find a site that you can use to do a simple background check on the applicants. Explain why you chose this site.
7. The hacker group *Anonymous* uses software to stage denial-of-service attacks against various targets—often political. Unlike most attackers, the group sometimes publicly invites people to “sign up” and add your computer to its group of attackers. Explain why it would be a bad idea to join this organization.
8. Talk to a friend or relative who works for a large company and ask about the types of monitoring that the company performs on its employees.

9. Use the Windows Task Manager to list all of the active processes on your computer. Search the Internet to identify the purpose of at least ten of the processes.

10. Assume you have a server with about 500 gigabytes of data. Identify the hardware and software you could use to make backups. Be sure to specify the price and estimate the amount of time it will take to back up the data.

Technology Toolbox

11. Write a short paragraph or spreadsheet. Encrypt and save it and e-mail it to a teammate. Identify a relatively secure way to exchange the password.

12. Find out if your computer has a Trusted Platform Module (TPM) that could be used with BitLocker drive encryption.

13. Most computer systems have administrator accounts that provide complete access to the computer for at least one person. Briefly explain what security issues this might cause.

14. Use the Web to find the best price on a security certificate that you can install on a business Web server. Assume that you will need the server for at least five years. To be safe, check your Web browser to ensure that the certificate authority is listed in the Trusted Root certificates.

15. If you have the appropriate network permissions, or using your own computer, create a Marketing group and three users on your computer. Create a folder and set the permissions so that the Marketing group can access the files in the folder. Add your instructor to the group and include a test file that he or she can read.

16. Check the security permissions on your computer—particularly the My Documents folder (or wherever you store most of your files). Is the folder secure or should you set different permissions?

Teamwork

17. Create a subdirectory on a computer that enables you to set access rights. Select a user or group and set permissions so members of that group can read the data but cannot change it. All other users (except yourself) cannot read the data.

18. Conduct a small survey of students (not in your MIS class). Find out how often they back up their data, the last time they updated their operating systems, and how many of them have been infected by a virus in the last 6, 12, and 24 months.

19. Create a simple chart in a spreadsheet and encrypt it. Send a version to each person on your team using a different password/key so that they can add a couple rows of data and return it. Combine the results into one spreadsheet. Comment on any problems you encountered.

20. As a group, create a list of questions that you would ask a potential employee who is interviewing for a job as a computer security expert at your company.

21. Each person should describe a movie scene or TV show episode that involve some type of computer security or attack. Explain whether the event is realistic. Swap the descriptions with team members and have each person add a list of actions that could be taken to prevent the attack.

Rolling Thunder Database

22. What privacy problems might exist at Rolling Thunder? What rules or procedures should you enact to avoid problems? Write a privacy statement for the company.

23. If Rolling Thunder Bicycles adds an Internet site to order bicycles and deal with customers, what security procedures should be implemented to protect the data?

24. Research the costs and steps involved in setting up a secure Web server for Rolling Thunder that can be used to sell bicycles over the Internet.

25. Write a disaster plan for Rolling Thunder. Identify how the backup tapes will be handled and the type of system you will need if a natural disaster hits.

26. Identify and briefly describe the top security threats that would be faced by Rolling Thunder. Outline the primary steps you would take to reduce the risks.

27. Particularly in terms of security, would Rolling Thunder be better off just hiring a company to build and run an e-commerce site?

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Cases: Professional Sports

The Industry

Professional sports raise billions of dollars a year in the United States and around the world. Actually, European professional soccer teams usually top the lists in terms of revenue. In the United States, baseball teams brought in $3.6 billion in revenue in 2001 ("MLB" 2002), basketball teams $2.7 billion in 2003 ("NBA" 2004), and football teams almost $5 billion in 2002 (Ozanian 2003). In 2010, baseball brought in $6.1 billion, basketball $3.8 billion, football $8 billion, hockey $3 billion, NASCAR $0.9 billion, soccer (top 20 teams worldwide) $5.2 billion (Forbes 2011).

These numbers include gate receipts as well as other revenue sources such as television payments. Of course, the teams also have enormous costs in the form of player (and coach) salaries. In total, sports franchises are the most popular segment of the entertainment industry. If you add in the amount spent on gambling (where it is legal, of course), sports are incredibly popular.

Information systems play several roles in sports management. Coaches, players, and scouts use information systems to track performance and opponents, store game files, diagram plays, and communicate information. IT is also used in the front office to sell tickets and merchandise. Like any other business, administrators have to derive financial information and evaluate customers and suppliers. Because of the popularity of the Internet and the role of television, sports teams have also begun to implement sophisticated networks within the stadiums for use by high-end customers.

Since the teams generally use networks to share information during games, security is critical. Any public networks have to be built separately from the team networks. Fans might be frustrated if a public network crashes or is hacked, but a team could be severely crippled if its main coaching system goes down or is compromised.

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Case: Professional Football

Football requires a large number of players, and that means a team needs a large number of coaches. The information technology system becomes relatively more complex to handle the increased number of users and machines. Brian Wright, IT director for the Chicago Bears, notes that "the NFL in general is looking closely at security and how best to protect the information in our business. One of the things we identified was the need for better user authentication" (Vijayan 2004). The team installed a USB authentication key that staff members use to log onto the network. They must also enter a PIN. The strength of the dual-factor authentication is that the PIN is relatively easy to remember, but outsiders cannot hack into the network because they would need the physical USB key.

The Denver Broncos focused on providing more information for fans—particularly the fans who watch the game from the luxury box seats. The IT department installed flat panel touch screens and a high-speed network into every box. Using the GamePlus system, fans can touch the screen and bring up the view from any camera in the stadium. Rick Schoenhals, IT director for the Broncos, notes that "I just know technology is gaining a bigger place in sports venues and sporting events. We're opening a new venue and we don't want to find out someone who opened next week is doing these great things with technology and we're not doing it. We can't be complacent in any area, including technology" (George 2002). The GamePlus system consists of 135 screens. The Broncos are trying to offset some of the costs by selling corporate sponsorships that display logos throughout the game. Because Denver was the first team to implement this type of system, the costs were relatively high.

Local area and wide area networks are important to improve communication within football teams, and many teams were early adopters. The Carolina Panthers installed a 100-mbps network in 1997. Roger Goss, MIS manager for the Panthers, comments on the speed by noting: "We needed that because the coaches create complex graphics, like playbook diagrams and game plans, and download them from servers to workstations" (Wallace 1997). The team also uses frame-relay links to other teams and to the NFL office. The connection is used to share statistics and to notify the league about trades and waivers. With 83 users, the system is heavily used on Monday to Wednesday when the coaches are creating and distributing game plans, and scouting reports arrive for the next opponent.

Sports teams are increasingly aware that fans want up-to-the-minute information on many aspects of the game. In 2000, the Washington Redskins created a Mobile Flash application to offer team news via Web-enabled cell phones and PDAs. Fans can sign up to receive daily e-mail messages about trades, statistics, and player injuries. The Redskins were the first NFL team to implement the wireless system—although others provide e-mail newsletters.

When the New England Patriots built a new 68,000-seat stadium in 2002, the network was a critical element. The voice and data networks alone cost about $1 million. The network uses Nortel Passport switches with a gigabit Ethernet backbone. It links 80 luxury suites and provides more than 2,000 ports at 100 mbps. The network is important to the teams and the fans. It is also important for renting the stadium to businesses during the week. Pat Curley, the IT director, notes that "no other stadium has this setup. It makes it very exciting, and very challenging" (Cummings 2002). The network supports the various coaching and scouting systems used by teams. The Patriots scouts use notebook computers with comments and data uploaded to the central servers for the coaching staff. The coaching system also stores digitized video so coaches can watch specific plays. Pat notes that the coaching system runs on a separate LAN. She says "we've designed everything to be separate so that people who need Internet bandwidth, such as the suite users and press, will have access but it won't conflict with or steal our bandwidth. Plus, it's more secure" (Cummings 2002).

After observing some of the problems that arose in New Orleans with Hurricane Katrina, Bill Jankowski, senior director of IT for the Baltimore Ravens decided it was time to establish a formal backup system for his team's data. Signing a contract with AmeriValut Corp., he transferred 200 GB of data to their servers, and every night ships update changes to their secure systems. For $3,000 per month, AmeriVault stores all of the team's video clips, injury data, and purchase data from the team's SQL-Server based transaction processing system (Fisher 2006).

Data security often extends beyond the digital world. Minnesota Vikings player Michael Bennet learned that the hard way in 2003. He received credit card statements with bills from various convenience stores. But the card did not really belong to him. Instead, an off-duty police officer working as a security guard for the team had stolen various documents from players and applied for credit cards in their names. The identity thief was caught in part from video surveillance tapes taken at one of the stores where he used the card. Several other well-known athletes have had problems with identity theft as well (ESPN 2003).

The high visibility of American football and television seems to attract attention. Just prior to the 2007 Super Bowl, the Web sites of the Miami Dolphin Stadium and the Miami Dolphins team were hacked and loaded with malicious code that attempted to infect any computer visiting those sites. The infection was first identified by customers who had the Websense security software installed on their PCs—it would not allow them to visit those sites because it detected the malicious code. Eventually, the owners of the sites were notified and they cleaned up the attack. Dolphins spokesman George Torres said that "we are working on the technology side to review all the code and do whatever we need to, on a security basis, to prevent this from happening again" (McMillan 2007). The code had links to servers in China that attempted to download Trojan programs on the visiting PCs. The code took advantage of a known exploit in the browser with patches issued by Microsoft.

The Dallas Cowboys were one of the earliest adopters of information technology and analytical tools. Much of the technology and data is now available to all teams, but the Cowboys are still leading the way at storing and handling data. In 2006, the team installed Isilon Systems servers to handle 19 terabytes of video data—enough to hold two entire season's worth of game video online. Video tapes of the games arrive from the NFL on Monday, Tuesday, and Wednesday. Robert Blackwell, director of coaching video for the Cowboys noted that "by the end of the day on Thursday, every game" is converted to digital format and stored in the system. By the end of the year, the system holds video for 263 games. Mr. Blackwell plans to continue adding storage so all video can be kept online and instantly available to coaches. The team also has a backup Isilon system that it carries to training camp (Fisher 2006). In the meantime, the NFL might want to talk with the Big-12 college football teams, including the Texas Longhorns. Instead of flying video tapes around the country, in 2006, the organization selected XOS Technologies to transfer digital copies of the videos to each team via the Internet. Each university in the Big 12 Conference can download entire games in about two minutes per gigabyte of data, or approximately two hours for one game film. Raymond

Thompson, VP of product marketing at XOX Technologies said that "you won't find anyone in the Big 12 who doesn't love Internet Exchange because of the time saved and the ease of getting it done" (Rosencrance 2006).

The Dallas Cowboys built one of the newest football stadiums in 2010-2011. The stadium hosted the 2011 Super Bowl and the giant scoreboard /replay screen above the field is only one of the most noticeable technology features in the stadium. In addition to the scoreboards, clocks, retractable roof, and lighting, the IT system runs point-of-sale terminals, ticket sales and so on. The stadium has 3,100 flat-screen televisions to show game scenes throughout the stadium, plus Wi-Fi, IP phones, and 300 IP security cameras. Housed in the stadium is a HP-based data center with 127 HP blade servers, 100 terabyte SAN, and high-speed network. OK, the data center runs team and stadium operations plus operations for team owner Jerry Jones' 35 other companies. But, the system has a dedicated staff of 13 IT workers (Taft 2011). Other stadiums are adding information features. The Meadowlands installed Wi-Fi capacity to support fans uploading photos and video. For Jets games, fans can access a FanVision device that feeds game stats and customized replays (Patterson 2011).

Questions

1. How can well-known stars protect themselves from identity theft?
2. What threats exist for portable computers used for scouting and how can those risks be minimized?
3. Would fans pay for mobile access to games? How much? What type of network would be needed to handle the data?

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Case: Basketball

The summer of 2003 was not a good year for the electricity grid in the northeastern United States. A combination of errors caused the international loop around Lake Erie to overload and shut down the power grid for the entire Northeast. Jay Wessel, the IT director for the Boston Celtics, was attending a picnic at 4:30 P.M., and he notes that when the grid crashed, "every cell phone and pager in the place went off" (Kontzer 2003). Because most of the blackout was focused in New York, he lost only some e-mail servers. Other teams had entire systems shut down. But, it convinced Wessel to look into ways to provide backup in case his facility lost power. The problem he encountered is that most backup facilities were also located in the same areas. He notes that "it doesn't really do me any good to back up my data 10 miles away" (Kontzer 2003). Like many other businesses, Wessel is also looking for solutions to the problems with virus and worm attacks. By keeping systems patched, his losses have been minimal, but he is frustrated with the frequency of patches required.

The Women's NBA teams have added a new twist to marketing basketball. When the Portland Trail Blazers acquired a new team in 2000, management turned to a CRM system to target sales to season ticket holders. They also merged demographic data from external marketing lists and Ticketmaster. Tony Cesarano, database marketing manager, notes that the system significantly improved the efficiency of the sales team and was able to sell 6,400 season tickets in four months. He notes that "in the past, we would have manually keyed the WNBA sales information into a Microsoft Excel spreadsheet, which would have been time-consuming and could have introduced inaccuracies into the database" (Baron 2000). The Trail Blazers are using customer relationship management (CRM) tools to boost sales of season tickets for the men's team. The system has consolidated the data that used to be scattered on spreadsheets of the 50 sales and marketing employees. It tracks individual ticket holders as well as corporate customers. One of the big gains was to minimize overlap, where multiple salespeople often called on the same prospects. The system has proved useful in managing requests by ticket holders to change their seat locations. It can quickly bring up unsold or released seats as well as track priority values of important customers. The organization ultimately expanded the system to their Web site. Cesarano notes that the process is complicated: "We'll have to manage a much larger volume of data coming off the Web. We'll also have to figure out how to clean up the data, to make sure that we're using only useful, legitimate, and accurate data" (Baron 2000).

The NBA in total boasts a fan base of over 50 million people for the 29 teams. In an attempt to boost the level higher, the NBA installed a customer relationship management system from E.piphany. Bernie Mullin, senor vice president of marketing, notes that "we're going to have a 360-degree view of the fans and customers of the NBA. We've never had that before at the league or team level" (Songini 2001). The system pulls data from all of the customer-interaction points: ticket sales, All-Star nomination ballots, the NBA store Web site, individual team databases, and the NBA store in New York. The main focus is to place the data into a data warehouse and provide analytical tools to sell more tickets. The plan is to track sales by various events to answer questions such as whether certain teams provide bigger draws, or if some months or days draw bigger crowds. The main NBA office in Secaucus, New Jersey, has about 1,000 employees. The NBA has several data collection and online systems to maintain. Two staffers attend each game with touch screen laptops to collect data. The data is transferred back to the main system at headquarters in real time. It can be used by fans to create custom highlight reels.

In 2007, the NBA created a site for fans in the Second Life Web site with games, interactivity, and community features. Visitors can gather in an arena to watch a 3D diagram of a game as it is being played in real life. The site also has a copy of the NBA Manhattan store to sell virtual merchandise for player's avatars. Through their avatars, fans can also play games, such as HORSE and a slam-dunk contest.

The Orlando Magic also implemented CRM software to help boost ticket sales. A primary focus of their system is to identify and track customer complaints. If customers have problems, the system can direct them to the appropriate vendor and monitor vendor compliance with contracts. Julie Gory, fan relations and retail manager, notes that "we are a watchdog department that looks at things from a fan's perspective. Whatever happens from when the fan leaves their driveway—everything from parking, the cleanliness of the restrooms—when we hear of issues, we make notes and input them to GoldMine and can review them on whatever basis we want" (Songini 2002). Gory decided not to use the NBA CRM software because it was too expensive—the NBA was going to charge them about $100,000. The system was also more complex and harder to use.

Video is critical to coaches and players. Digital video provides enormous benefits over tape because it can be edited and indexed quickly. The New Jersey Nets were the first team to implement a comprehensive system from Ark Digital Technologies. The system lets coaches quickly grab the clips they want based on various statistics. Ark CEO Alan Kidd notes that "during halftime, coaches could show clips of the first half by type, for example, jump shots or post positioning" (Kreiser 2002). Ark has also created a digital video coaching system. The system can show basic drills. Ultimately, it can be coupled with the game-day videos so players can go to a Web site and compare their performance with the drills (www.arkdigitalsystems.com).

In 2006, the Celtics began actively using analytical software from SratBridge to analyze ticket sales and prices. Daryl Morey, senior VP of operations for the Celtics uses the tool to fill the 18,600 seats by changing prices and offering package deals. He said that "until we had this tool, it was very difficult to create dynamic packages, because our ticke providers didn't have a rapid way to see which seats were open. Now we can actually see in real time every single seat and how much it is sold for." The analytical tool has also revealed that in certain sections fans prefer aisle seating, so the organization has learned to focus on marketing the interior seats for sales promotions (Havenstein 2006).

In 2007, the Atlanta Hawks and Thrashers implemented a new payment system for season ticket holders. Those who signed up for a Chase credit card can use their cell phones to pay for food or merchandise at 200 POS terminals in the arena. Additionally, their phone's Web browsers can read RFID tags embedded in posters in the concourses, directing them to a site where fans can view and download game information, videos, and promotions (Mitchell 2007).

By 2010, the NBA had its own 85-person IT department with a CIO. The team is responsible for game-time issues handling networks and computers, as well as maintaining the NBA Web site and New Jersey tech center on a daily basis. For the finals games, video and stat loggers tag video clips with metadata so anyone can quickly find video clips based on various criteria. CIO Michael Gliedman noted that "We come up with a whole set of metadata that can be used in lots of ways," including by video game developers (Brown 2010).

The NBA produces and distributes an enormous amount of video, with 1.9 billion videos viewed from the NBA.com Web site in the 2010/2011 season. (Los Angeles Times 2011). NBA Digital supports season passes to watch games online and also provides the NBA Game Time app for Android and Apple phones which displays game statistics and scores.

Questions

1. What privacy issues arise from the NBA using a CRM system to track customer purchases?
2. How can the CIO of a basketball team provide backup facilities for a small-to-medium-sized network?
3. How long will it take for digital video coaching technology to be implemented at the college level?

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Case: Baseball

Sports fans, particularly in baseball, are often crazy about souvenirs. They will collect almost anything. So, it is not surprising that outdated copies of baseball contracts found their way to an e-Bay auction set up by Scott Gaynor, a sports memorabilia dealer. Bob Tufts, who played for the San Francisco Giants and the Kansas City Royals in the early 1980s, found that his contracts were among those offered for sale. While there is nothing illegal per se about the sale, there was an important twist: As employee contracts, most of the documents contained the social security numbers of the players. With some big-name players in the group (read "money"), the risks were quite high. Bob Tufts observed "I'm shocked to find out how easy it is for people to get their hands on files like these" (Rovell 2003). With a home address, the social security number, and a guess at a mother's maiden name, criminals could have created fake bank accounts. The commissioner's office requested that the auction be stopped and the contracts returned. Some of the bids had reached $200 before the items were pulled.

The Internet is increasingly important for attracting fans to all sports. Since baseball has been number-intensive for years, Web sites are an important source of data on games and players. In 2001, all major league baseball teams agreed to consolidate and standardize their Web sites. All of the sites are now run from the MLB servers. All sites were given a common look. An interesting aspect to the change is that revenue from sales on the site is split across all of the teams. Bud Selig, the commissioner, observed that "the most significant part of our whole Internet activity was the unanimous vote to share the revenue. That was a very dramatic change in thinking, because disparity is the biggest problem we have" [Wilder 2001]. Bob DuPuy, chief legal officer in the commissioner's office adds that "Of course, we agreed to share revenues that don't currently exist. I don't think we could do it at a later date when there was revenue disparity" (Wilder 2001). The site is operated by a separate company created by the team owners and run in New York City. The new organization was initially funded with $1 million a year for three years from each of the 30 teams ($30 million a year). In a somewhat risky move, the MLB site sells video access to games. The risk is that it could alienate traditional television broadcasters—who provide a substantial part of baseball revenues. But the site is still subject to local blackout rules, and the picture quality is not even close to television standards. So, its market would most likely consist of out-of-area fans.

Season tickets present interesting problems for clubs and fans. About 80 percent of them are owned by corporations—particularly the luxury suites. Robert McAuliff, CEO of Season Ticket Solutions, notes that "season ticket holders… miss 25 to 50 percent of games every year" (Rosencrance 2001). The challenge for teams is that filling seats increases revenue through sales of food and souvenirs. The challenge for fans is that they want to efficiently use their investments. The Phoenix Diamondbacks, as well as other teams, have purchased software that enables season ticket holders to manage their seats. The Web site allows ticket holders to check on who is using the tickets, and which dates still have seats available.

Web casting ball games is an interesting legal and marketing area. Are people willing to pay for Web broadcasts? Do they want to select specific games? (Currently, MLB offers a subscription but only to specific games.) Would such a system encroach on television broadcasts? Is there a profit? Many of these questions remain unanswered, and it is not clear that anyone is seriously addressing them yet. In 2000, William Craig and George Simons created a company and the iCraveTV Web site in Canada. The company picked up signals from 17 broadcast stations in the United States and Canada, digitized the signals and offered them for free on its server. Rebroadcasting signals is legal in Canada. But it is a violation of U.S. copyright laws. The company was quickly sued by several U.S. sports agencies as well as the Motion Picture Association of America, because the company did not block the signals to U.S. customers. The company quickly made an out-of-court settlement and shut down the site (McGeever 2000). So, many questions remain about whether fans want to see Internet, or even cell phone video of games. And, if so, how much they might be willing to pay and whether those fees would offset any lost television advertising revenue.

With its experience and in-house staff, MLB has become the leader in Web casting large events. In 2006, more than 5 million people watched March Madness college basketball games on the Web—thanks to MLB technology. MLB sells the services to at least 25 clients, providing a profitable stream of revenue for MLB. Bob Bowman, CEO of MLB.com, observed that "content publishers were being underserved. A lot of companies are having a hard time picking out a digital strategy…Music has iTunes, but that is not a total solution. So it was obvious that we had something if we used it right." (White 2006). Mr. Bowman and others are concerned that the ISPs might make life more difficult for them—the phone companies have stated that they want to charge fees for carrying bandwidth-intensive programs like streaming video. Mr. Bowman notes that "Just receiving a live feed and sending a compressed version over the Web is difficult. We didn't anticipate how in-depth it all was." The 30 MLB teams financed MLB.com with an infusion of $60 million and jointly own the organization. The site relies heavily on Akamai Technologies to distributed the content to its 18,000 servers worldwide—reducing the bandwidth demands on any one server.

MLB.com charges $80 a season for fans to watch almost any live game they choose. The site also uses software from Open Text to store and tag all of the content—providing customers with access to video clips, statistics, and other data in a non-linear format. That is, fans can search for and select events to see, including highlight clips and summaries of games. Justin Shaffer, VP and chief architect for MLB.com noted that "we wanted to take advantage of new media in order to provide a better experience for baseball fans worldwide via MLB.com…As we continue to catalog and distribute exciting game footage for our fans, our partnership with Open Text ensures that we can easily provide those fans with the types of products that match their needs, whether it's game summaries, highlights or other specialized cuts of video" (Rosencrance 2005). In 2009, MLB launched its own network on cable TV. Video from every major league game is routed to the Secaucus NJ studios, compressed into HD and standard definition video and then routed to satellites for transmission by cable companies (Mark 2009).

Once fans are at the stadium, they need to pay for things like souvenirs, food, and beer. And no one wants to stand around fishing for change and signing credit-card slips. The San Francisco Giants were an early adopter of contactless payment readers. Newer credit cards have RFID chips embedded in them and customers simply hold the card a couple of inches from the reader to activate the payment. Not many customers have the RFID cards yet, but it simplifies payments for those who do have them. Ken Logan, IT director, also plans to issue season ticket holders with a special card that gets them into the stadium and handles payments at the concessions by linking through a database back to the holder's credit card. So far, Logan said "the only drawback is just keeping people from spilling a beer on it. They get pretty dirty and sticky" (Mitchell 2007).

Any business wants to track its customers, and baseball is no exception. Teams routinely send out e-mails and promotional information to ticket holders. In 2011, a staffer for the New York Yankees sent a standard newsletter to several hundred season ticket holders. The only problem is that a spreadsheet was attached to the message that contained personal data for 18,000 season ticket holders. The spreadsheet did not contain credit card data but it did have phone numbers, addresses, names, seat numbers, and Yankee account numbers (McMillan 2011).

One of the more amazing technologies to be introduced to baseball was tested in 2009 by Sportvision, a Bay Area company that developed the yellow first-down marker for football. The new camera and software system is designed to automatically track the location of every ball and every player on the field. It will have the ability to generate data on how fast fielders respond to hits, how hard they throw the ball, and other statistics that have never existed before. The data could introduce big changes in how defense is evaluated in baseball (Schwarz 2009). The system was first tested in San Francisco and uses four high-resolution cameras to capture three-dimensional data. Sportvision tested the FIELDf/x system in the San Francisco stadium in 2010 and was preparing to deploy it to other stadiums.

Umpires play a key role in any baseball game. As much as fans like to complain about some of the calls, the talent and knowledge of the umpires is amazing. It takes training and practice to stay up-to-date as a major league umpire. So MLB and IBM teamed up to install special Web-based software to help umpires. Umpires use WebSphere technology to build mashups of the game, calls, and players. They can leave notes for umpires at the next game. The portal lets them view videos of certain plays, help analyze controversial calls, and provide detailed explanations of rulings (Boulton 2008).

Questions

1. How are player privacy rights different from average citizens?
2. What procedures can be implemented to help protect players from identity theft?
3. What are the benefits and drawbacks to centralizing the team Web sites for MLB?
4. How could a team provide individual customized access to baseball games via the Internet?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 6

Transactions and Enterprise Resource Planning

Chapter Outline

What You Will Learn in This Chapter

- How do you process the data from transactions and integrate the operations of the organization?
- How do you efficiently collect transaction data?
- What are the major elements and risks of a transaction?
- Why are transactions more difficult in an international environment?
- How do you track and compare the financial information of a firm?
- What are the transaction elements in the human resources management system?
- Can a company become more efficient and productive?
- How do businesses combine data from operations?
- How do you combine data across functional areas, including production, purchasing, marketing, and accounting?
- How do you make production more efficient?
- How do you keep track of all customer interactions? Who are your best customers?
- How can a manager handle all of the data in an ERP system?
- How does the CEO know that financial records are correct?
- Why do most companies avoid cloud computing for ERP systems?

Ford Motor Company

How do you manage a huge organization? How can you integrate data from hundreds of divisions scattered around the world? Bill Ford, great-grandson of Henry, turned around the struggling manufacturer in the early 2000s. Along the way, he made an amazing discovery: it is more important to sell vehicles at a profit, instead of trying to just sell more at any cost. With hundreds of facilities, Ford, like the other automobile manufacturers, has an immense job of ordering parts, keeping factories scheduled, identifying cars and features that customers actually want, tracking production, monitoring sales, and designing for the future. Having pioneered the mass-production systems of the 1900s, Ford is only now learning to build a more flexible manufacturing system—where one plant can produce different car makes. Information technology plays a key role in making the factories and the entire operation more efficient.

Although the company is publicly held, the family exerts significant influence on it. After former chairman and CEO Donald Petersen rubbed the family the wrong way, he retired prematurely. Alex Trotman took the position in 1995 and hoped to retain the Ford family support. On January 1, 1999, the disappointed Ford family replaced Trotman as CEO with Jacques Nasser. Nasser came from the international side of Ford, which was experiencing strong sales. In 2001, a series of crises, capped by the Firestone tire recall on the Explorer led to high tensions in Ford and in the industry. On October 29, 2001, Bill Ford, Jr., fired Jacques Nasser and installed himself as CEO. On September 5, 2006, the company replaced Bill Ford with Alan Mulally from Boeing.

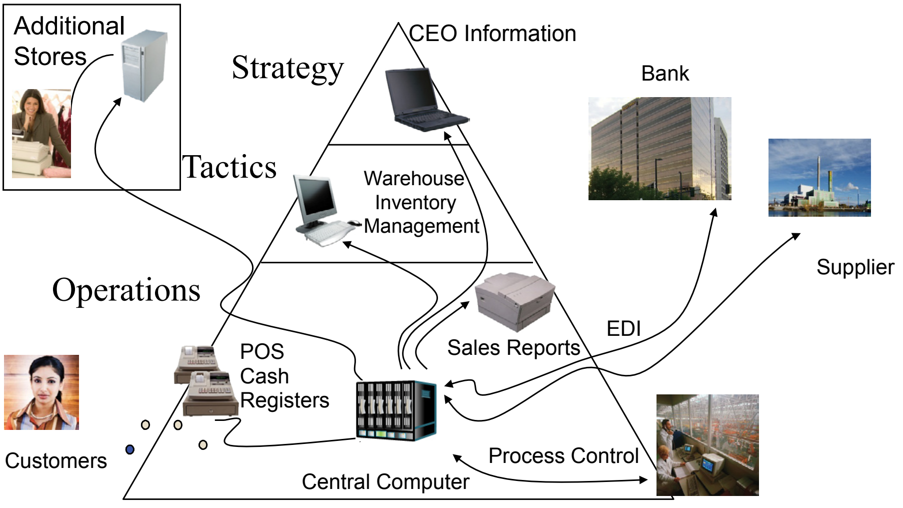


Figure 6.1

Transactions and Enterprise Resource Planning Integration. The goal is to collect all operations data and share it throughout the organization. Links to suppliers and banks improve integration and provide more options for the firm.

Introduction

How do you process the data from transactions and integrate the operations of the organization? This question has been asked repeatedly for centuries. In fact, it has driven the organizational structure of companies. What were firms like in the 1800s or earlier? Most were small proprietorships. As firms became larger, how could they handle the thousands of daily transactions? Hierarchical structures evolved to collect data at the point of sale, summarize it, and move it up the chain of command to the CEO. Figure 6.1 shows how transactional data is exchanged with customers, suppliers, manufacturing, and banks, and summarized for higher-level decisions. Think about the problems that arise if groups within the company (accounting, production, marketing, and so on) all have different databases. When you have computers today that can capture all of the operations data automatically, do you still need a hierarchical structure? Instead, an integrated system running on a database can be used to share data with everyone.

Whenever two people make an exchange, it is called a transaction. Transactions are important events for a company, and collecting data about them is called **transaction processing**. Examples of transactions include making a purchase at a store, withdrawing money from a checking account, making a payment to a creditor, or paying an employee.

Because of the importance of transactions, companies built systems to track the various aspects, including accounting, human resources, and production. As computer hardware, software, and database technology improved, it because clear that companies needed integrated systems that held all of the data or enterprise-level systems. These tools are complex, but can collect data on all aspects of the organization, including access for employees, managers, customers, and suppliers. The

Trends

Because of legal ramifications, businesses have always collected data about transactions. Accounting systems play an important role in collecting and analyzing transaction data. Through the 1960s, most business computers were primarily producing basic accounting reports. Raw data was punched into the computer by hand, and the computer produced totals and updated the general ledger. In effect, the computer was used as a giant calculator to automate the production of printed reports similar to those used before the advent of computers. The primary reason for using the computer was speed and accuracy. It was justified because it was cheaper and less error-prone than hiring thousands of people to produce the reports.

As computer capabilities increased in the 1970s, the most important change was to use the computer to collect the raw data. In retail sales, the cash register was replaced with a computer terminal and a bar code scanner. Whenever a customer purchased an item, the transaction data was immediately sent to the main computer. This automation eliminated the need to hire a person to enter the data at the end of the day.

The 1980s and 1990s resulted in more integration. Transaction data was made available to managers throughout the company. One goal was to combine the systems across the company into an enterprise system that enabled managers to examine all aspects of the business.

By the late 1990s, integrated systems could support data for the entire organization. Accounting packages handle all accounting information tasks, HRM systems handle employee-related chores, and manufacturing systems deal with production. These enterprise-level systems were designed from the ground up to handle all of the major information tasks of a company. Beyond simple access to data, integrated systems make it possible to change the way the company operate.

integration of data from all areas of the organization from marketing, production, human resources, and accounting leads to new methods of doing business.

Data Capture

How do you efficiently collect transaction data? The basic components of a transaction-processing system are illustrated in Figure 6.2. The focus is twofold: accomplishing the transaction and capturing data. Data capture consists of gathering or acquiring data from the firm's operations and storing data in the computer system. Entering data into the computer can be time consuming and difficult. For instance, banks have invested heavily in automating the collection and recording of transaction data. Yet because many transactions are based on paper, clerks still spend considerable time entering data. First, tellers enter the data into their terminals. Then a bank staff reads the dollar value written on checks and deposit slips. The bank staff works through the night, typing the amount into a machine that codes the number on the bottom of the check so it can be read by other computers.

As the volume of transactions increased, businesses looked for faster and more accurate ways to get data into the computer. Four basic methods are used to collect data, depending on its source. The data-collection method consumers are most

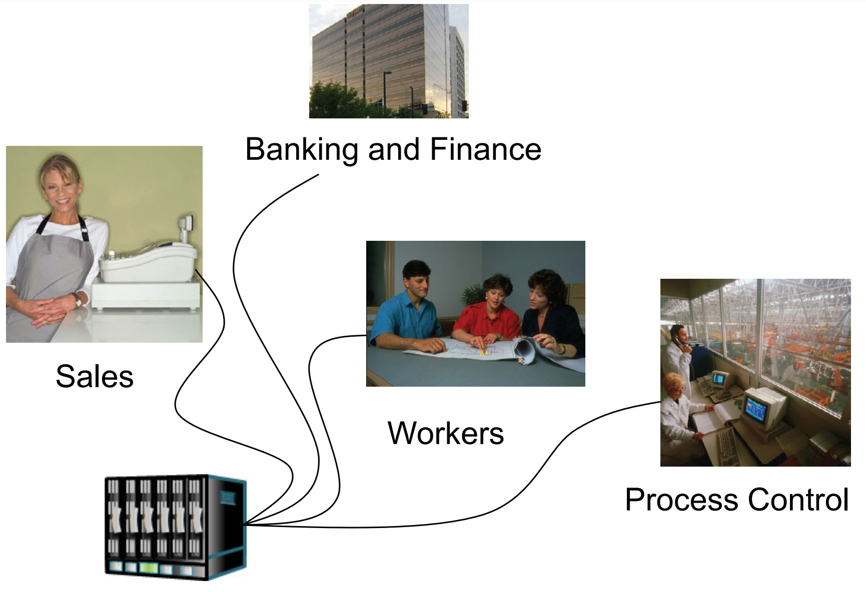


Figure 6.2

Data should be captured as soon as it is generated. The operations level generates data from many sources. Modern systems collect the data in a central database and make it immediately accessible to managers.

familiar with is **point of sale (POS)**, where the sales register is actually a computer terminal that sends all data to a central computer. On assembly lines, robots and manufacturing equipment can collect data, such as quality control measures, and return it to a computer. Typically the computer also can send control instructions to these machines. This exchange of data between manufacturing machines and computers is known as **process control**. The third way to collect data automatically involves the exchange of information with organizations outside the firm, especially suppliers and customers. Instead of dealing with paper records such as purchase orders, it is possible to send orders electronically through a process called **electronic data interchange (EDI)**. The fourth method is to have the customers select products and enter data directly into the electronic commerce Web site. This fourth method offers the potential of reducing errors and costs—if the Web sites are built carefully and if the customers are motivated and capable of selecting the products themselves.

Point of Sale

Several devices have been created to capture data at the point of the sale. Some companies rely on keyboards to enter data, but high-volume areas have switched to bar code scanners. All consumers are familiar with bar code scanners that read the universal product codes (UPCs). The scanner reads the code and sends it to the computer, which looks up the corresponding name and price. The computer prints the receipt, stores the sale information, and automatically decreases the inventory count.

Reality Bytes: Pay By Phone

In 2011, several companies began a push to find a mechanism to use cell phones to make everyday payments. The catch is that several technologies are available, but no one can agree on which method to use. As Omar Green from Intuit points out, “There’s a lot of money at stake if it’s done right.” Some examples include Starbucks, which has an application to display a pre-loaded Starbucks card on a smart phone that the cashier can scan. The Bump application can transfer PayPal cash from one phone to another. Laura Champers of PayPal noted that the company processed $700 million in mobile payments in 2010—a tiny fraction of the $70 billion it handles in total. FourSquare also offers methods to transfer money to other phones. But, none of them are likely to be adopted by typical retail vendors. Instead, the credit card companies are trying to extend their reach through Near Field Communication (NFC) which uses a chip similar to RFID with a shorter range. Put the credit card number on a chip and put the NFC chip into a cell phone and customers can wave the phone in front of a scanner. It is really just a credit card in a different format and could be handled by taping a card to the back of a phone. The main wireless carriers (Verizon Wireless, AT&T, and T-Mobile) also are trying to get into the game by creating the Isis network to work with Discover Financial. Some of the largest banking companies have also been working on alternatives. But, without the support of the credit card companies, it is likely to be difficult to gain any traction with retail stores.

Adapted from Laurie Segall, “Your Mobile Phone is Becoming Your Wallet,” *CNN Online*, January 19, 2011.

Another type of scanner is used by the U.S. Postal System—**optical character recognition (OCR)**–to read handwritten zip codes, allowing mail to be processed and sorted faster. Even so, the post office hires thousands of workers to type in data that the scanners cannot read. Banks use a process called **magnetic ink character recognition (MICR)** to process checks and deposit slips. MICR readers are more accurate than straight OCR because they pick up a stronger signal from magnetic particles in the ink. A few companies are using speech recognition technology to enable workers to enter data by speaking to the computer. Speech recognition enables the users to enter data while leaving their hands free to do something else.

The newest data-acquisition technology is **radio frequency identification (RFID)**. Bar codes have two major limitations: (1) they hold a limited amount of data, and (2) even the best scanners have trouble reading them. Basic bar codes can hold 10 digits, but 5 of those are used to identify the manufacturing company, which leaves only 5 digits for the actual product. As a consumer, you have certainly encountered bar codes that are difficult to read. RFIDs are small chips about the size of a grain of rice that consist of an antenna and some transistors. When the scanner sends a radio signal to the chip, the antenna receives it and uses the radio waves to power the transistors and return the stored data by modifying the scanner wave. For several years, people have implanted the chips in their dogs in case the pet becomes lost and loses his or her collar. The capacity and range of RFID chips depend on the frequency (low, high, or ultra-high). The ultra-high frequency chips can be read from the greatest distance (12 feet with a maximum of 40)

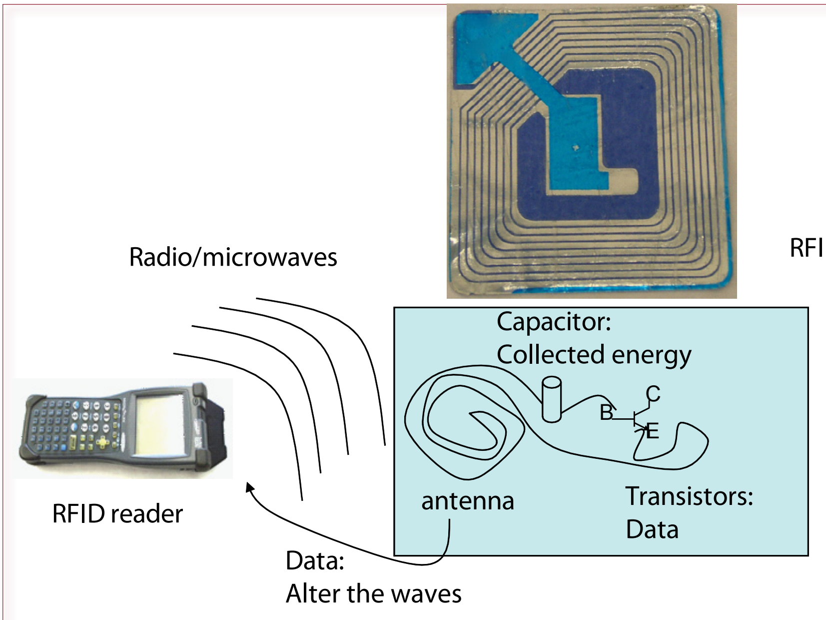


Figure 6.3

RFID capture. The antenna on the tag captures the power from the radio signal to release the data in the transistors and modify the wave signal so that the stored ID can be retrieved.

but hold only 12 bytes of data. The high-frequency chips are typically scanned at less than a foot (with a maximum of 10 feet), but can hold from 8 to 10,000 bytes of data. The ability to read the tags from a distance provides a substantial advantage in supply chain or warehouse environments. Figure 6.3 shows that you no longer have to scan each item from a few inches. You can walk down the aisles with a reader and quickly pick up and distinguish the RFID tags from hundreds of products at a time. The main drawback to RFID at the moment is that the tags are relatively expensive—around $0.20 each. But if you have to count inventory in a store or warehouse several times a year, the RFID tags could save you substantial time and money, plus provide improved accuracy. The scanners also have limitations on the number of items they can recognize at one time. For example, it is doubtful that a single scanner could read the RFID tags from an entire truckload of products at one time.

Wal-Mart and the U.S. Department of Defense are pressing suppliers to put the tags on all items shipped to Wal-Mart. Using their dominant market position, Wal-Mart is asking suppliers to bear the cost of the tags. However, at this point in time, it is probably not economically feasible to include the tags on small, low-price items. Instead, the tags are typically placed on pallets or boxed shipments. RFID tags at this level will probably not be useful in the store itself, but it will help to identify items received and track them through the supply chain delivery system.

Reality Bytes: New Job: Chief Digital Officer of NYC

With the increased sales of smart phones, more people are carrying around devices that be used to obtain and share information. The QR code is a useful method to tag items so people with smart phones can quickly receive information about objects carrying the code simply by taking a picture of the code. New York City hired Rachel Sterne as a chief digital officer to help figure out where to put the codes. The City uses the codes on building permits to enable people to link to the underlying blueprints and construction records. Residents also suggested putting the odes on mass-transit locations, such as bus stops so riders can use them to get up-to-date schedules. Other suggestions included parks and art work—to provide detailed data to interested viewers.

Adapted from Zachary M. Seward, "Where Should New York Place QR Codes?" *The Wall Street Journal*, February 24, 2010.

Ultimately, if tags become cheap enough to place on all items, retail stores might be able to radically alter their format. For instance, scanners could be embedded in shopping carts or doorways. Customers would simply select the items, and get an immediate price and running total. Payment could be virtually automatic as well, so customers could skip the checkout lanes. Cart-based systems could also suggest related products or direct customers to aisles with similar products. Sound far-fetched? Albertson's (a grocery chain) began experimenting with these tools in some of its stores in 2003. Most customers were reluctant to use hand scanners and scan everything themselves, but if RFID tags could be used to simplify the process, it might be more useful.

Some privacy advocates have argued against RFID tags on the grounds that if all of your clothes contained these tags (as originally proposed by Benetton), it would be possible to track individual people. However, the limited range of the scanners, coupled with the ability to deactivate or remove the tags, can reduce or eliminate this problem.

Two-dimensional codes (squares) are used in some operations. UPS was one of the first to use them to route and track packages. Today, the QR code standard developed by Denso Wave Incorporated in Japan is available for many purposes. Figure 6.4 shows a sample QR code that was generated from an online Web site. Increasingly, cell phones with cameras can be used to take a picture of a QR code and the encoded data provides a link to a Web site with detailed information. Several Web sites will generate QR codes for free based on the data or Web site you enter. Although the extra data capacity can be useful for packages, the power of smart phones makes the QR codes appealing to marketers. Products, displays, even billboards now carry QR codes to encourage people to obtain background information. Cities, such as New York, are adding the codes to various places, such as bus stops, parks, and public documents. Museums and public art displays are adding them to provide background information about various pieces.

The QR code examples point out some important features of transaction data. Primarily, the format has to be standardized—and it helps

Figure 6.4

QR codes. A two-dimensional bar code that can contain thousands of characters, the QR code was initially created to track auto parts by Denso Wave, Inc. in Japan. Most cell-phone cameras can read the codes so it is often used to link viewers to Web sites containing marketing or background information.

if the standard is free of royalty payments. Also, the codes need to contain enough data to be useful. The old bar codes, and even RFID chips do not contain much data. Larger capacity also improves the capability of the code to handle error correction—where the data can be recovered even if some of the code is destroyed or covered. The presence of low-cost readers—such as cameras on cell phones—ensures the adoption and spread of the code.

POS Advantages

Several advantages arise from using automated data entry. Directly capturing data means fewer errors occur because the machines make fewer mistakes. However, sometimes it is not easy to collect data at the source. POS systems also have built-in error detection methods to make certain the numbers are read correctly. By collecting the data immediately, it is easier to find and correct mistakes. If a clerk using a POS system enters an incorrect product number (or the scanner reads it incorrectly), the error can be caught immediately.

With POS data collection, the computer performs all necessary computations immediately. Hence, the job is easier for clerks and fewer errors will occur. For example, a retail store might give discounts to certain customers. With a POS system, the employees do not have to keep track of the customers or discounts, because the computer can look up the discounts and apply them automatically. Similarly, prices are maintained and changed by the computer. To hold a sale, you simply change the price in the computer (one place) and put up a new sign. Of course, when there are thousands of items and prices, there are still plenty of opportunities for errors.

POS systems also can provide better service to customers. Because the sales data is captured immediately, the managers and clerks always know the inventory levels. If a customer calls to learn whether a product is in stock, the clerk can instantly determine the answer. With most systems, it is possible to tell the computer to hold that item until the customer picks it up. Some companies even connect their store computers together. If you find that one store has run out of a particular item, the clerk can quickly check the other stores in the area and tell one to hold the item for you.

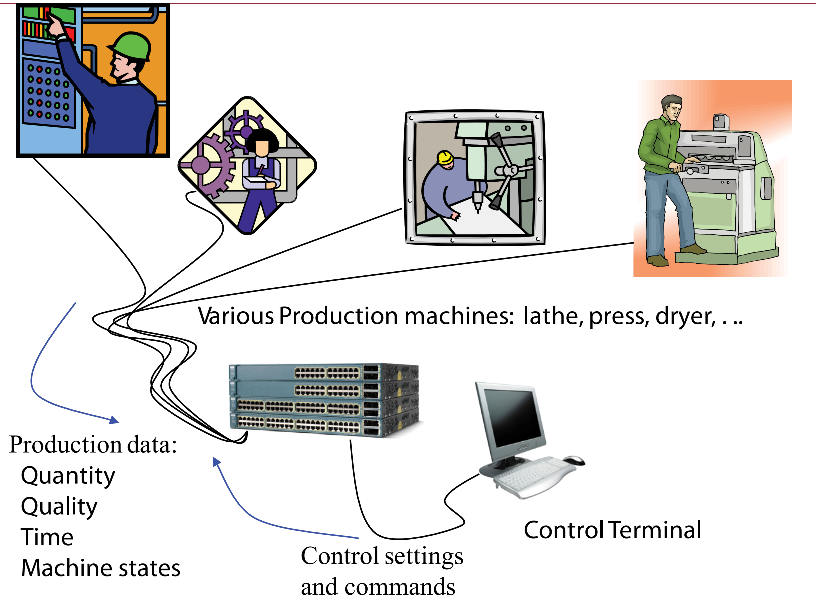


Figure 6.5

Process control is the control of production machines from centralized computers. The computers monitor data from the machines and make continual adjustments. The central control enables designers to specify all production settings from one location.

Process Control

Manufacturing firms often deal with a different type of data. Most factories use machines that can be connected to each other and to computers. The computers can exchange data with the production machines. If you want to alter your product, you would need to change the manufacturing settings on several different machines. If the production line has 10 machines, each with 5 control items that need to be set, it could take several hours to reset the entire production line. And then you have to test and verify every setting. Even a minor change in the product means that someone has to set each of the machines correctly. By connecting the machines to a computer, the computer can store the appropriate settings. When you make a change in the product, the computer sends the correct settings to all the machines. Computers are often used to monitor the progress of the production line. The data is used to identify problem spots and to help the firm meet production goals. Figure 6.5 illustrates the basic concept of individual machines controlled from one location.

Technology also can be used to collect data from manufacturing machines. With this communication, the computer can constantly monitor production levels. Managers can keep track of hourly and daily production, and even track individual products. If a customer wants to check on the progress of a special order, the manager can determine how much of the product has been produced and when it is likely to be completed.

Process control computers can also be used to monitor quality in the manufacturing process. Sensors can automatically measure almost any characteristic. They can check for items such as thickness, weight, strength, color, and size. These

Reality Bytes: Mobile Payments a Tough Sell Without Credit Card Companies

Wireless carriers announced the intention to scale back plans for payments by phone only a couple of months after the joint venture Isis was formed. The goal was to create a new payment method involving cell phones, where carriers would take a percentage of transaction revenue. The main problem was that the system would compete directly against credit-card companies, notably Visa Inc. and MasterCard Inc. Retail merchants and customers are unlikely to use a system that does not include the two biggest players in payments. Drew Sievers, CEO of mFoundry which provides mobile banking technology, noted "Not including the 800 pound gorillas of the industry will make it very hard to succeed." But, the card companies do not need the carriers, so they no longer have a way to take a cut of the revenue. A Nilson Report notes that in 2010, 57.2 percent of debit or credit card purchases were handled through Vias, and another 25 percent by MasterCard.

Adapted from Robin Sidel and Shayndi Raice, "Pay-by-Phone Dialed Back," *The Wall Street Journal*, May 4, 2011.

measurements can then be passed to a computer. If the computer notices a trend or a major problem, it can notify the operators. In some operations, the computer can send messages to the machine causing the problem and reset its controls to correct the problem automatically.

Two basic difficulties exist with process control. First, the large number of machines makes it difficult to establish standards, making it harder to connect the various machines together. Second, production machines can produce an enormous amount of data. Some machines can generate billions of bytes of data per hour. This large amount of data requires efficient communication lines, high-speed computers, and a large storage capacity. Despite these complications, process control can provide enormous advantages. It enables companies to change production processes and alter products faster and more often. It provides better information and control over quality. It enables manufacturers to create products that match the needs of individual customers: mass customization.

Electronic Data Interchange (EDI)

EDI is a form of automated data entry that supports operations by transferring documents between firms electronically. The essence of EDI is the ability to transfer data among computers from different companies. The goal is to connect to suppliers so that production orders can be sent automatically at substantially lower cost than traditional paper-based systems. Two basic methods are used to accomplish the transfer: (1) send the data directly from one computer to the other or (2) send the data to a third party that consolidates the data and sends it to the proper location. Early EDI implementations were based on direct connections as individual firms experimented with the technology. In both methods, two important considerations exist: establishing the physical links and transferring data in a format compatible to all users. The first issue has largely been solved with the Internet. Today, EDI connections can be established through e-mail or Web site links.

For EDI to work, each company must translate its data into a form that can be used by the other companies. If one company like Wal-Mart or GM takes the lead

Reality Bytes: QR Codes from Ethical Bean Coffee Co. Connect to Customers

Ethical Bean Coffee Co. is a small three-store chain of coffee shops in Vancouver, British Columbia. Similar in some ways to Seattle, Vancouver has a surplus of coffee shops on every corner. Seeking a way to stand out, in 2010, Ethical Bean started putting QR codes in its train ads. When customers use their smart phones to scan the QR Code, a menu appears on their screens. Customers can order a cup of coffee while riding the train and pick it up when they arrive at the Ethical Bean shop. CEO Lloyd Bernhardt notes that business has doubled since adding the QR codes and that "We catch people who are on the go and don't have a lot of time." QR codes are easy to generate—several Web sites make it easy to enter a URL or e-mail address and will generate the square bar code free. Scanbuy, Inc., a New York company that develops QR code advertising estimates that 30 million U.S. people have a code reader on their phone. Companies still have to print and distribute the codes in their advertising. Ryan Goff, director of social-media marketing at MGH, Inc. cautions that "QR codes are not the end-all, be-all. They may not exist in two years. But they're a temporary solution to the problem of 'How do you connect people to online things in the real world?'"

Adapted from Emily Glazer, "Target: Customers on the Go," *The Wall Street Journal*, May 16, 2011.

and requires suppliers to send data via EDI, then they are free to define the base transaction objects. Suppliers must translate their objects into the appropriate EDI structure. Yet a supplier might need links to several customers. If each customer used different EDI definitions, the supplier must have a conversion system for each link. Someday it might be possible to create standards for EDI connections, forcing everyone to conform to one type of data definition. Although there is some progress in this area, firms with existing EDI systems will be reluctant to spend the money to convert their data.

Data conversion might sound like an easy task, but it is complicated when the transaction systems were created over long periods of time and were poorly documented. In many cases, the programmer might have to search major portions of the corporate systems to find the appropriate data definitions. Once the appropriate data is found, it can be hard to modify. Existing programs might expect the data to maintain specific formats. Making changes to the data can require rewriting other programs.

The concept of EDI is closely tied to **Supply chain management (SCM)** which revolves around purchasing, but also incorporates just-in-time delivery, searching for competitive pricing, and controlling and monitoring quality.

Proprietary EDI

As displayed in Figure 6.6, most of the early EDI systems were created independently: one large company required suppliers to provide data and accept orders electronically. The goal was to cut the costs of transactions and speed up the ordering process. EDI arrangements also enabled manufacturers to improve quality control and to implement just-in-time inventory systems. Suppliers were "encouraged" to adopt the EDI systems by threatening a loss of sales if the vendors did not comply.

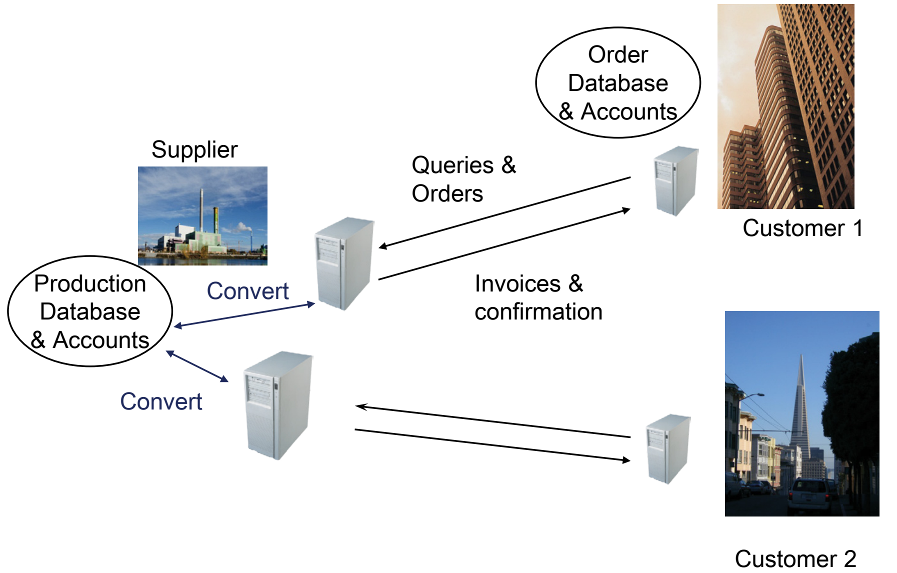


Figure 6.6

EDI can be built from individual pair-wise links over proprietary connections. If the majority of transactions are between two companies, this method will work fine. If companies deal with many different suppliers or large customers, this method can cause problems when each link requires conversion to a different format.

With proprietary systems, the lead firm establishes the standards in terms of the hardware and the types and format of data to be exchanged. From the standpoint of the lead firm, these controls ensure that they are able to connect to each supplier with one standard technique.

To a supplier, proprietary systems created by one company can lead to problems. Imagine what happens when the supplier sells to several firms, and each firm requires the use of a different EDI system. In addition to the hassles of providing data in the proper format for each customer, the supplier's employees would have to learn how to use several different systems. Purchasers face similar problems unless all of their suppliers follow a standard.

EDI Standards and The Internet

Multiple proprietary systems lead to confusion and higher costs. Consequently, several companies have tried to push for standards that make it easier to share data. Two primary standards exist for EDI messages. The UN sponsors the Edifact standard; the United States defined the ANSI (American National Standards Institute) X12 definition. Figure 6.7 shows the overall structure of an EDI message. A significant difference between the standards is in the numbering system used to represent the types of messages, segments, and data elements. Figure 6.8 presents a partial list of the segment types available in the X12 standard. The standards also specify the exact format of the data required in each segment type.

Web sites are used to advertise and display information about products and their availability. Search engines enable companies to find components and potential suppliers quickly. EDI transactions such as orders and request-for-prices can

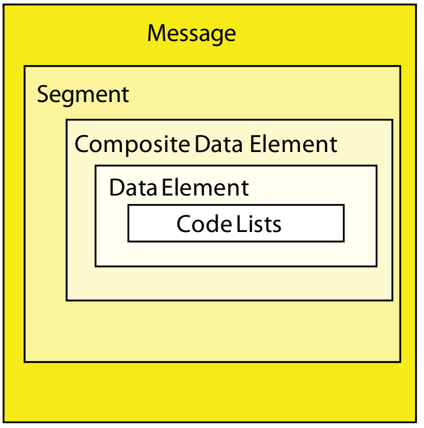


Figure 6.7

EDI standards. UN Edifact and U.S. ANSI X12 standards are similar in format; each message consists of segments and detailed data lists. Each message, segment and data element are defined by numbers from a predefined list of possible transactions. There are substantial differences in the numbering system used for the segments and data.

Figure 6.8

Sample segment codes for ANSI X12. A partial list of the codes used within X12 EDI messages. Only the number is transmitted. Each segment specifies the format of the additional data.

104 - Air Shipment Information
110 - Air Freight Details and Invoice
125 - Multilevel Railcar Load Details
126 - Vehicle Application Advice
127 - Vehicle Buying Order
128 - Dealer Information
129 - Vehicle Carrier Rate Update
130 - Student Educational Record (Transcript)
131 - Student Educational Record (Transcript) Acknowledgment
135 - Student Loan Application
139 - Student Loan Guarantee Result
140 - Product Registration
141 - Product Service Claim Response
142 - Product Service Claim
143 - Product Service Notification
144 - Student Loan Transfer and Status Verification
146 - Request for Student Educational Record (Transcript)
147 - Response to Request for Student Ed. Record (Transcript)
148 - Report of Injury or Illness

```xml
<?xml version="1.0"?>
<!DOCTYPE OrderList SYSTEM "orderlist.dtd">
<OrderList>
<Order>
<OrderID>1</OrderID>
<OrderDate>3/6/2004</OrderDate>
<ShippingCost>$33.54</ShippingCost>
<Comment>Need immediately.</Comment>
<Items>
<ItemID>30</ItemID>
<Description>Flea Collar-Dog-Medium</Description>
<Quantity>208</Quantity>
<Cost>$4.42</Cost>
<ItemID>27</ItemID>
<Description>Aquarium Filter &amp; Pump</Description>
<Quantity>8</Quantity>
<Cost>$24.65</Cost>
</Items>
</Order>
</OrderList>
```

Figure 6.9

XML for EDI. Data is sent in a standard format that is easy for computers to parse and read. Industry groups have been establishing standard formats and tags for exchanging EDI data within their industries.

be handled over the Internet as e-mail messages. The Internet can also host secure communication channels between two partners. These links can be used for high-volume exchanges of data.

Extensible markup language (XML) was developed in the last couple of years to provide better Internet support for EDI. At its foundations, XML is a tag-based document that contains data. As shown in Figure 6.9, the tags indicate the type of data contained within the document. The document can have a hierarchical structure similar to the EDI standards, such as Order – OrderItem – Product. Various industry groups have been establishing standard document formats (data type definition or DTD) for common documents within their industries. Many software packages can read and write XML documents, so companies can use diverse hardware and software and still communicate easily.

Figure 6.10 shows the sample XML document using a browser. XML is the means to exchange data in a form that all computers can read. At least, that is the promise and hope. XML is still evolving and is still relatively expensive to implement because it often requires customized programming on both ends to handle the data. Software vendors are developing tools that incorporate XML automatically, and suppliers will be able to purchase the software needed to handle the multiple connections to customers.

Extensible Business Reporting Language (XBRL)

The Securities and Exchange Commission (SEC) is responsible for monitoring financial aspects of businesses in the U.S. to protect investors and maintain fair, orderly, and efficient markets. The SEC collects and publishes financial data by

```
<?xml version="1.0" ?>
<!DOCTYPE OrderList (View Source for full doctype...)>
- <OrderList>
  - <Order>
      <OrderID>1</OrderID>
      <OrderDate>3/6/2001</OrderDate>
      <ShippingCost>$33.54</ShippingCost>
      <Comment>Need immediately.</Comment>
    - <Items>
        <ItemID>30</ItemID>
        <Description>Flea Collar-Dog-Medium</Description>
        <Quantity>208</Quantity>
        <Cost>$4.42</Cost>
        <ItemID>27</ItemID>
        <Description>Aquarium Filter & Pump</Description>
        <Quantity>8</Quantity>
        <Cost>$24.65</Cost>
      </Items>
    </Order>
  + <Order>
  + <Order>
  </OrderList>
```

Figure 6.10

XML document. XML is designed to transfer data between companies and computers. You can define any type of tag to describe the data.

firms, including annual reports, balance sheets, and income statements. The commission has required firms to submit data electronically for several years. In 2011, the commission moved to require most companies to submit data using a new standard: **extensible business reporting language (XBRL)**. XBRL is largely an XML-based system for tagging specific financial data. Background information is available at www.xbrl.org, and www.sec.gov/xbrl.

The accounting discipline has been around much longer than computers have. Although one goal of accounting is to create standardized views of company performance, accountants and companies have evolved different terms over time. For example, revenue, earnings, and income are all terms that have been used to represent the same concept, and any financial document might use different variations of these terms. These differences make it difficult for computers to read and extract data from financial statements—even if they are in HTML or other digital format. XBRL is designed to encourage accountants to tag all of the data in a statement with a standardized name so that it can be retrieved electronically.

Of course, financial reports are more complex than just lists of numbers. For example, they include footnotes and descriptions. And even the data contains other attributes such as the time period and currency. XBRL has tags and options to handle most of these issues. Figure 6.11 shows a simple example of a tag that is used to display the Revenue for a specified year. This tag can be embedded in a typical XHTML document which can handle the overall layout and formatting. The attributes on the <ix … > tag provide the type of data (name=”ifrs:Revenue”), the units or currency “EUR”, and the actual data to display (6,863,545).

```
<ix:nonFraction
  contextRef="y2012"
  format="ixt:numcommadot"
  name="ifrs:Revenue" unitRef="EUR"
  decimals="0" scale="0"
  id="XWAND00000326">
    6,863,545
</ix:nonFraction>
```

Figure 6.11

XBRL document element. Note that all of the data elements are tagged with standardized identifiers and with attributes that specify the time frame and currency. Source: http://media.ifrs.org/ixbrl_example1_2011-03-25.xhtml

Unlike typical XML, XBRL is not designed for transferring transaction or EDI data. Instead, the tags are defined specifically for reporting summary data. Yet, this data is increasingly used by many people: investors, banks, fraud investigators, and so on.

Elements of a Transaction

What are the major elements and risks of a transaction? Transactions are a critical foundation of modern economic societies. In many ways, transactions define and enable different types of societies and cultures. A transaction consists of an exchange of a product or service for money. Consequently, there is always a risk that something might go wrong in the exchange. Figure 6.12 summarizes the transaction risks that are borne by the vendor, the customer, and the government. The laws and culture determine how these risks are minimized.

Vendor Perspective

At heart, a vendor cares only about one fundamental aspect of transactions: receiving the money. This simple statement has several complicating factors: (1) the payment might never arrive, (2) the payment might be fraudulent, (3) the customer might repudiate the transaction and withhold the money, or (4) the government might invalidate the transaction.

In older times, these risks were minimized through personal reputation of the customer and money based on precious metals. More recently, in our mobile, anonymous society, credit card companies have stepped in to assume much of this vendor risk—for a price. The credit card companies and credit bureaus provide identification and personal reference services. Under the proper conditions, the card companies effectively guarantee payment to the merchant. The conditions primarily consist of (1) keeping good transaction records and (2) identifying the customer through either a magnetic swipe of the card or a signature.

Customer Perspective

In some ways, customers face a more complex set of risks. Their primary concern lies in receiving the identified value for their money. Specifically, they want to be sure that (1) they receive the product or service that they ordered, (2) they are charged only the amount they agreed to pay, (3) the seller does not repudiate the

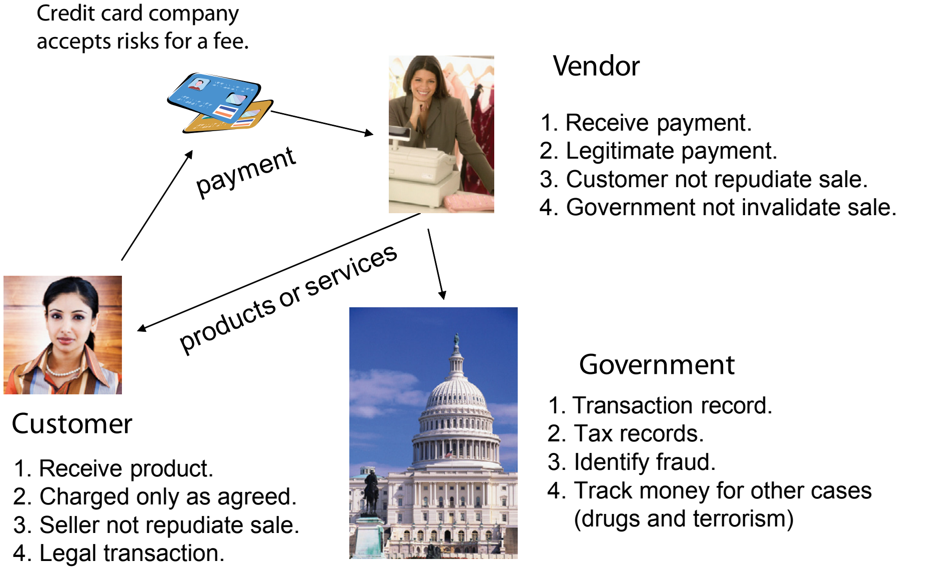


Figure 6.12

Transaction risk factors. Risk elements and causes vary depending on the transaction method. Laws and business procedures are created to minimize these risks, so new laws are needed when transaction methods change.

transaction such as by claiming the product was stolen, and (4) the transaction is legal—for example, not stolen goods that could be confiscated.

In older times, these risks were small when customers shopped at local stores, could physically examine the goods, paid in cash, and received a written receipt. Identification and reputation of the merchant were critical. Even so, fraud was a problem. Again, credit card companies stepped in to reduce much of this risk. Today, credit card companies warranty products, ensure delivery, and validate the merchants.

Transaction Fees

While often invisible to consumers, the fee for using a credit card consists of a percentage of the transaction cost paid by the merchant. Of course, economics shows that the price of the product reflects a portion of this fee, so the consumer and merchant both bear the cost. The cost depends on the size of the merchant, the card company, and the size of the transaction. Typical fees are 1.5 to 5 percent, with minimum costs of about fifty cents per transaction.

What about payments by check instead of credit card? In this case, the vendor bears a relatively high risk that the check is invalid or will be refused for insufficient funds. While there are laws against check fraud, the merchant would experience high costs to recover the money. Consequently, vendors generally contract with specialist firms to validate and process checks. Again, the merchant pays a fee to transfer this risk to another company.

Reality Bytes: You Cannot Buy That

Most people are comfortable buying just about anything using credit and debit cards. But, many people are not aware that the card companies prohibit them from buying certain items. Currently, the list is relatively short, but the point is that the card companies do have this power and no oversight or appeal process exists. What items are banned? The basic list is gambling chips (in casinos), online gambling, online pornography, donations to at least one non-profit organization (WikiLeaks), and medical marijuana. The online gambling case is understandable, because online gambling has been declared illegal by the U.S. government. Medical marijuana falls into the same category. Although some states have made it legal to buy small amounts of marijuana, the federal government still outlaws the purchase of marijuana, so card companies are concerned about their liability. Still, some customers want the option to use their cards for all purchases. The issue of gambling chips is much harder to defend—and the card companies have not even tried to explain. Note that they do allow gamblers to withdraw cash using their cards at casino ATMs—with exorbitant fees and interest charges. The online pornography issue is defended by noting that the number of chargeback claims on those transactions is huge, so the card companies are trying to reduce fraud costs. Still, it should be possible to institute more secure methods for people who want to use their cards. Blocking donations to WikiLeaks is far more disconcerting. Yes, the U.S. government leaned on banks and card companies to block transfers to the site. But, it was not a U.S. organization, and WikiLeaks has never been tried in a court for any legal violations. As John M. Simpson from the non-profit Consumer Watchdog put it "You ought to be able to use a credit card for any legal purchase. It seems to me that credit card companies are imposing their moral values on the world."

Adapted from Quentin Fottrell, "What Your Credit Card Won't Let You Buy," *The Wall Street Journal*, May 31, 2011.

Government Perspective

When discussing transactions, many people forget about the perspective of the government or society. Yet several government organizations have a strong interest in transactions to protect various members of society. The primary interests include (1) an auditable record of transactions and financial statements for the protection of investors, (2) a record of taxable transactions for the collection of sales tax, (3) identification and tracking of fraudulent transactions, and (4) general tracking of money used in transactions to monitor other types of crimes, such as drugs and terrorism.

Most government interests are established by laws and administrative rules that are enforced through manual audits of financial documents. Some data is collected from transaction partners, such as the $10,000 cash reporting rule in the United States. On the other hand, governments are rapidly becoming aware of the jurisdictional problems inherent in electronic commerce. The most prominent issue is the inability of states to force out-of-state firms to collect sales taxes for them.

After a few embarrassingly huge fraud cases in the upper echelons of companies in the early 2000s, Congress got tired of hearing CEOs trying to avoid criminal charges by saying they did not know anything about the problems created by their underlings. So, Congress passed the Sarbanes-Oxley Act that requires exec-

Figure 6.13

Some international issues with transactions. The basic issues of language, exchange rates, and tariffs are straightforward. Processing shipments through customs can be challenging. Bigger problems arise if something goes wrong because of the different jurisdictions.

utives to take responsibility for all financial reports. The top executives have to certify that the accounting reports accurately represent the status of the firm. The act has scared many executives—not enough to give up their huge salaries and pensions—but they are beginning to search for ways to validate the transaction and financial systems. It is no longer sufficient to just record transaction data—now firms have to institute processes and ensure that people follow them to guarantee that the correct data is being recorded.

International Issues

Why are transactions more difficult in an international environment? In the early stages of e-commerce, several people suggested that the Internet's global reach would make it easy even for small businesses to sell products internationally. However, several factors interfere with international sales. Figure 6.13 summarizes some of the major points involving sales into other nations. Jurisdiction for dispute resolution is a major issue. Nations have many different laws and cultures. Tactics (and content) that might be commonplace in one country could be illegal in another nation. Gambling is a classic example. The United States might ban gambling on the Internet, but how can it enforce that law? On the other hand, if a U.S. citizen has a dispute with an overseas casino, there would be few options to protect the consumer. Similarly, fraud and Web attacks can easily originate from several different nations. Varying laws and lack of coordination make it difficult to identify and prosecute the perpetrators.

Privacy and payment methods present additional challenges. The European Union has privacy rules that are substantially stricter than those of other nations, and it does not want international companies transferring personal data to comput-

Reality Bytes: More Ways to Transfer Money Online

American consumers rarely use checks or cash. Credit and debit cards are still important in transactions, but online payment methods—particularly PayPal—continue to grow in popularity. In May 2011, three of the largest banks in America announced a new service to make electronic payments. The banks involved (Bank of America Corp., Wells Fargo & Co., and J.P. Morgan Chase & Co.) are in a joint ventured named clearXchange. Mike Kennedy from Wells Faro and chairman of the new venture, noted that "Customers want to move payments from paper to electronic methods, so if we can meet our customers' financial needs, they will be better customers with us." The service will rely on the cell phone and is aimed at person-to-person transfers. Money will be transferred directly from checking accounts to another account based on a linked e-mail address or phone number. Initially, the service was released in Arizona and carried no transaction fees; but banks might eventually add fees for the service. Small businesses could also use the technology to avoid paying processing and merchant fees for credit and debit cards. A survey by consulting firm Aite Group LLC noted that in 2010 U.S. households made $865 billion in payments between individuals in 11 billion transactions. Dividing by the number of households yields an average of $7,500 and 96 transactions per household.

Adapted from Robin Sidel and Amir Efrati, "Big Banks Join Battle for Online Payments," *The Wall Street Journal*, May 25, 2011.

ers outside of the Union. Identifying vendors and customers is also problematic when nations utilize different payment mechanisms. Although the major credit cards are accepted in many nations, many people do not use them. For years, transactions between international businesses were largely handled with specialized documents issued among large international banks. With the increasing importance of the Internet, leading to international sales to individuals, these issues become more difficult to solve. Credit card companies and banks largely protect consumers, but international crime makes the task more complex. More importantly, vendors are largely unprotected so many companies are reluctant to sell directly to international customers.

The Role of Accounting

How do you track and compare the financial information of a firm? Accounting systems are important because they extend throughout the company and because they focus on money. They are used to collect data and evaluate performance. Accounting systems also enable managers to combine the many divisions into an integrated picture of the entire company. Accounting systems also provide controls over the data to ensure accuracy and to prevent fraud. The primary purpose of accounting is to collect the financial data of the firm, ensure that it is accurate, and create standard reports. It is hard to capture all of the elements of an accounting system in one illustration, but Figure 6.14 summarizes the essential components of an accounting system. The accounting transaction system can be examined in terms of inputs, outputs, and processes.

If you are not going to be an accountant, why do you need to understand accounting, and why review it in an information systems book? The short answer is that the accounting information system provides the foundation data for the firm.

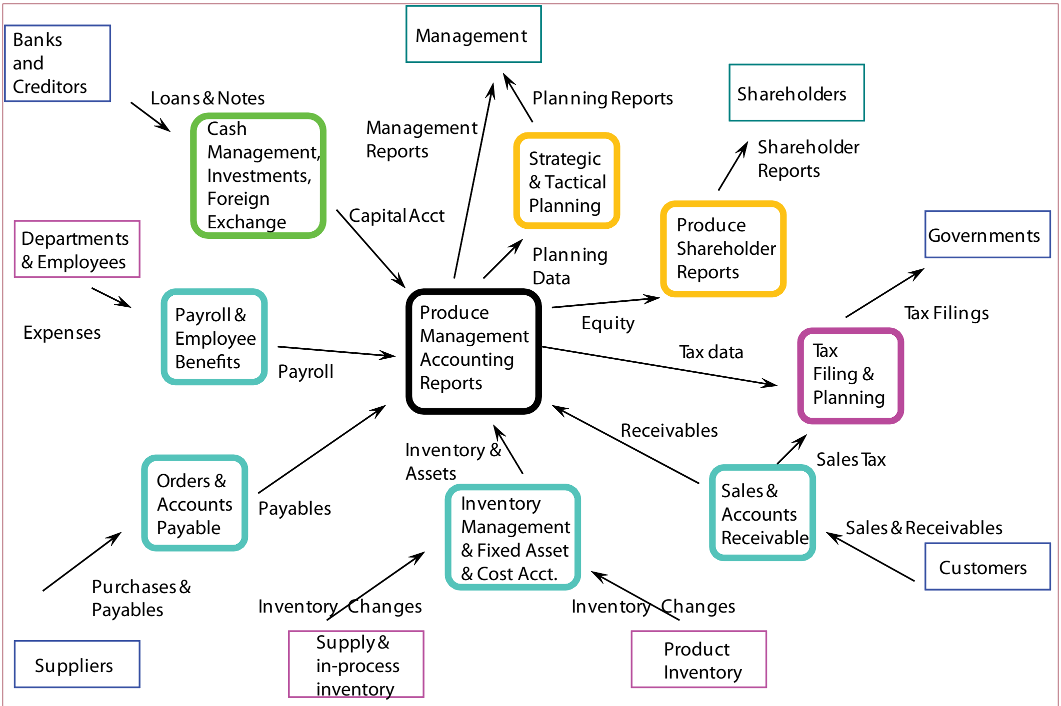


Figure 6.14

Transaction processing is a major function of the accounting system. The accounting system collects data throughout the company and produces consolidated (centralized) reports that are used for planning and management.

The longer answer revolves around the fact that the accounting process is increasingly automated in companies. As a result, all managers have to understand and analyze accounting data. You will have access to basic accounting data and reports directly from the computer. It will be your responsibility to monitor the changes and understand the effects.

Input and Output: Financial Data and Reports

Raw financial data is collected by the accounting department and stored in an **accounting journal**. Modern accounting requires the use of a double-entry system to ensure accurate data. In a double-entry system, at least two entries must occur for every transaction. Generally, one entry records the effect of the money (e.g., cash, accounts payable, accounts receivable), and the other refers to a specific category (e.g., sales, office expenses, commissions). Each entry includes the date, amount of money, account number, the name of the person or firm involved, perhaps a comment, and the name of the person making the entry. The journal's purpose is to record all the transactions.

Journal entries represent raw data. To be useful, this data must be transformed into information. The first step is to categorize the data by *accounts* or categories, which is the purpose of the **general ledger**. The ledger is a collection of accounts that break the data into specific categories. Common categories include *accounts receivable, accounts payable, inventory*, and *cash*. Although some standards

Reality Bytes: Vending Machine Payments

Vending machines can be useful, but they typically have one big problem: They only accept cash. Today, people buy most items with credit and debit cards. If people could pay with cards or even their cell phones, it is possible that sales at vending machines would increase. In 2009, U.S. sales fell 10 percent to about $20 billion—partly because of the recession. Operators would also gain data on specific sales so items would be less likely to run out and they could track the top- and weakest-sellers. The technology exists, so the decision seems straightforward. The problem is that the technology is relatively expensive. And most vending machines are run by small firms who cannot afford the technology. John Mitchell Jr. runs one of larger operations. Treat America Ltd. Of Merriam Kansas, runs about 12,000 vending machines. He notes that "You're catering to a population that might be as small as 30 or 40 people. The unique preferences of that population can drive sales significantly." The company originally stocked machines based on average preferences of the region. In January 2010, Mr. Mitchell converted about 40 percent of his machines to record real-time sales data; which showed that about 40 percent of the 45 slots were "dead spirals" selling fewer than one item per week. Installing a wireless system costs about $300 on a $3,000 machine, and vendor profit margins are typically only one or two percent.

Adapted from Ilan Brat, "Restocking the Snack Machine," *The Wall Street Journal*, August 3, 2010.

exist, each company can define its own **chart of accounts**, which allows owners and managers to examine data on whatever categories are important to their firm. Defining the chart of accounts is one of the important steps in managing a business because it defines the type of information you will examine on a daily basis.

For managers to make comparisons between divisions and other firms, accounting systems produce standardized reports. Most companies produce balance sheets, cash flow statements, and income statements every quarter. These reports are produced following standard accounting rules to enable owners, managers, and investors to compare the financial positions of various companies over time.

Purchases, Sales, Loans, and Investments

One of the primary purposes of accounting is to record the financial transactions with external organizations. In addition to collecting the raw data, the accounting system contains controls that minimize fraud by limiting access to the data. The system also creates summary and detail reports to monitor key information.

Managers often build **exception reports** into the accounting system that are triggered when some event occurs. If sales in some region suddenly drop, if there is a major increase in the cash balance, or if inventories fall below a defined level, a message will be sent to the appropriate manager. The manager typically responds by searching the recent summary reports for a possible cause.

Inventory

Most organizations need to control inventory carefully. Retail stores find it hard to sell items that are not in stock. Manufacturing firms need to receive and process parts as cheaply as possible. Inventory control consists of knowing exactly what

Reality Bytes: Chiquita ERP Problems

In 2006, Chiquita Brands, based in Cincinnati, began a multimillion-dollar upgrade to consolidate its accounting systems and centralize budget planning and forecasting. Operating worldwide with three semi-autonomous business units, the company faced many challenges, including software bugs, staffing shortages, and resistance from the business units. Even after four years, the company was struggling to get all of the components to provide value. CIO Manjit Singh noted that "The general perception is, we got it to work. But it was painful, and the [managers] aren't necessarily looking at this as a successful implementation… Once we start using it for forecasting, I'm hoping the reaction to the project will turn more positive." The system was based on Hyperion and is designed to consolidate data used for forecasting. The goal is to remove e-mailed spreadsheets from the process and get financial planners to use the centralized system so everyone sees the same data and same analyses at the same time. Singh noted that Hyperion (now owned by Oracle) sold the project to the finance group and bypassed IT. IT was called in to support the project after the contracts had been signed.

Adapted from Robert L. Mitchell, "Inside Chiquita's 'Painful' Finance System Overhaul," *Computerworld*, August 9, 2010.

items are available and where they are located. The system also needs to determine when to place new orders. It must then track the orders to make sure each item is delivered to the appropriate location at the right time. With EDI, the inventory control system can monitor current sales and automatically place orders with the supplier.

Manufacturing firms use these systems to implement just-in-time inventory control. The computer system monitors the current production requirements, keeps track of deliveries, and electronically sends orders to the suppliers. The suppliers then deliver the parts just as they are needed on the production line.

Automated inventory control systems also help identify and prevent theft. By recording all movement of items from receipt to sales to shipping, management knows exactly how many items exist. Consider a retail store like a bicycle shop. The computerized inventory notes that there should be three *Cateye computer speedometers* in stock. Yet when a customer asks to buy one, you notice there are only two left. If there is no mistake in your inventory report, you conclude that someone stole one of the items. Although the system did not prevent the speedometer from disappearing, it does show which items are susceptible to theft. It also helps control theft by employees, who will be less likely to steal if they know that the items are carefully monitored.

The Accounting Cycle

An important aspect of accounting systems is that they produce information in specific cycles. Firms are required to produce reports that reflect the financial condition of the firm at the end of every quarter. Accounting systems are based on these requirements. For the most part, managers operate from quarterly reports, with intermediate monthly reports for some items. Because of the volume of data in the detail, most companies keep only current statistics and summary reports on file. Older data is shuffled off the system to make room for the current numbers. As a result, managers may not have easy access to detailed data from prior years.

Technology Toolbox: Selecting an ERP System

Problem: How do you select and evaluate ERP systems?

Tools: : Several ERP systems and even more ERP consulting firms exist to give you choices and help you evaluate your options. Choosing a system is relatively difficult because of the costs. The cost of the hardware and software is high, but you face larger costs in converting from your existing system and redesigning your business processes. Once you have implemented a particular ERP system, it is difficult to switch to another vendor. So, you have to be careful to select a system that is going to work for your particular organization. Today, most large companies already have ERP systems, so the growth market lies with small and midsize businesses. Most of the ERP vendors are actively targeting this SMB market. Businesses within this category have to pay attention to the anticipated growth and scalability options of the software systems. For example, even small businesses can gain the advantages of ERP systems by leasing them from companies that host the software on Internet servers—you pay only a monthly fee.

In terms of technical business features, most of the large ERP systems are somewhat similar—offering the standard accounting, HRM, SCM, and CRM integration. However, you will find differences in ease of use, internationalization, and customization options. For a smaller business, one of the more important areas to look at is the quality of the predefined industry-specific application. Most ERP vendors provide shells that are customized for each industry, so it takes less time and money to set up the system for your company.

Planning Stage	Goals and Outputs
Initiation	Estimate costs, establish objectives, select team
Initial planning	Initial vendor list and basic features (hardware platform, fees, internationalization, vendor size and stability, and so on).
Requirements gathering	Identify business requirements. Detailed list of specifications, unit goals, and critical features. Evaluation criteria.
Demos and selection	Product demonstrations, ratings, and site visits.
Implementation	Customize applications, convert data, restructure company operations, define new processes, and train employees.

Selecting an ERP system is a time-consuming task, and you have to carefully evaluate the needs of the company. You will create lists of primary objectives and generate detailed specifications. You will endure hundreds of hours of vendor presentations and comparisons of databases, reports, and customization capabilities.

Then you have to implement the solution. Many companies work with a partner consulting firm that specializes in one ERP system. This detailed knowledge simplifies the conversion process because the consultant firm has experienced experts. But even midsize firms take six months to a year; larger operations can require a year or two. Most companies choose to implement ERP systems in stages—perhaps accounting first, followed by SCM and CRM. Even these packages can be split and implemented in smaller pieces.

Quick Quiz:

1. Assume you work for a midsize construction firm that does about 30 percent of its work internationally. Find at least three ERP vendors and outline the features they provide.
2. Assume you work for a large retail clothing firm with stores in most U.S. states. Identify the specific accounting and financial features you would want in an ERP system.

Process: Controls, Checks, and Balances

Double-Entry Systems

An important objective of accounting systems is to maintain the integrity of the financial data. The goal is to prevent mistakes and discourage fraud. Double-entry accounting provides a method to locate mistakes in data entry. If an amount is entered incorrectly, the account totals will not balance.

Because many transactions involve outside organizations, mistakes can be caught by sharing data. Every month firms receive a statement from the bank. The totals can be compared to changes in the firm's cash account. Similarly, companies typically send receipts when they receive payments from each other. Auditors periodically send verification requests to suppliers and customers to make sure the data was recorded correctly. EDI strengthens this approach, because transaction data is transmitted in computer form among the companies.

Separation of Duties

Another type of control is the separation of duties. A manager in the purchasing department might be responsible for choosing a supplier of parts. Only the accounting department can authorize the transfer of money to the supplier. The objective is to minimize fraud by requiring a potential thief to deal with multiple employees.

Many banks take this concept a step further. They require employees (especially tellers) to take their vacations every year. Several instances of fraud have been revealed when the employee was no longer at the job to keep the fraudulent mechanism running.

Audit Trails

An **audit trail** is important to accounting systems. It enables investigators to track backward through the data to the source. A cash flow statement might indicate that the company has spent twice as much money this month as last. To find out why, trace backward and find all of the raw entries that make up the number. Together with dates and amounts, the raw journal entries can contain the identity of the person responsible for the entry. By keeping this identification data, it is possible to list every article that affects an item on a report.

Human Resources and Transaction Processing

What are the transaction elements in the human resources management system? Every company has employees. Companies collect hundreds of pieces of data for each employee—some for management purposes, others because they are required by law. For years, the human resources (HR) department focused on filling out and storing forms. The enormous amount of paperwork alone begs for computerization just to cut down on storage space needed. Computerized databases also enable managers to find specific data on employees. Early HR software emphasized these two benefits. Modern HR software is expanding beyond simple forms to improving data collection and providing better analyses. To illustrate the problems presented by large-scale transaction-processing systems, consider the three areas of input, output, and processing.

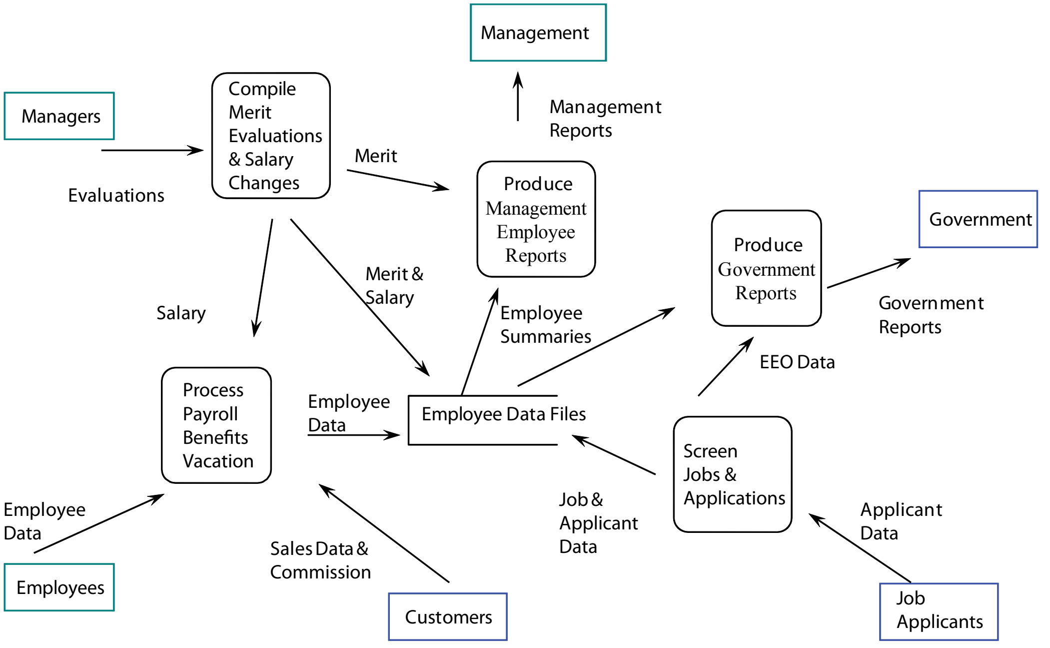


Figure 6.15

Most employees know that human resources management (HRM) deals with payroll and benefits. But HRM also collects data and produces reports for a myriad of government reports, oversees employee evaluations and job applications. The department also handles training and education opportunities.

Input: Data Collection

Figure 6.15 illustrates the basic components of a human resources management (HRM) transaction-processing system. Note that the system is even more complex because the data comes from all areas of the company. To understand how the HRM systems became so complicated, begin with the obvious data that needs to be collected: numbers related to the payroll. For hourly workers, the system needs to collect and monitor hours worked. For many sales tasks, the system must compute sales by employee to determine commissions. Professional service firms often ask employees to track their time in terms of billable hours for work that is charged back to clients. In all three situations, as the number of employees increases, it becomes increasingly difficult to collect all of these statistics and verify their accuracy. It also becomes harder to find specific pieces of data.

Think about paychecks you have received. In addition to the payment amount, there could be 10 to 20 other numbers on the pay stub. Companies monitor and report several types of payroll taxes, including federal, state, local, Social Security, and health. Also, firms monitor employee benefits, such as health care and retirement. Most firms also handle employee deductions for employee purchases, savings plans, stock purchases, parking, meal plans, and other options. In some situations, companies must garnishee wages and forward them to a third party.

Human resource departments also track days taken for vacations, personal time, and illness. In larger companies, HRM provides training courses and offers testing of critical skills. Employee attendance and performance data is stored and incorporated into evaluations.

With the increasing use of merit pay, the system must also track employee evaluations. Some performance measures are tied to productivity or output within the employee's department, so HR must relate employee work schedules to production and quality measures. Most companies use a centralized HRM department to advertise job openings and to screen the initial applicants, verify credentials, and keep basic employment and hiring data.

Output: Reports

The human resources department also produces several reports related to payroll. Along with printing checks, HRM must provide expense reports and forecasts to the accounting system. Periodic reports are created for job vacancies and analyses of employee performance and morale.

HRM departments also spend a great deal of time creating reports for various government agencies. All companies must file various economic reports dealing with employment. Tax-withholding data must be filed regularly with federal, state, and local agencies. HRM departments create equal employment opportunity reports detailing characteristics of their workforce, job applicants, and hiring decisions. Then there are various reports required by the Occupational Safety and Health Administration (OSHA) regarding injuries and exposure to various hazards. If employees need to be certified, companies file aggregate reports with the various regulatory agencies. All of these reports have deadlines.

In addition to the standard reports, the human resources department is responsible for maintaining compliance with all relevant employment laws. Hence, HRM staff must continually monitor the employment data and evaluate it for exceptions and problems.

Process: Automation

The human resources department is a busy place. Keep in mind that the data and reports apply to every branch of the company. Even standard items such as paychecks become complicated when the company is split into several divisions scattered across the country. Also, remember that accuracy is crucial. Employees can become upset if their paychecks are wrong. Errors with government reports can lead to fines and lawsuits. Equally important, companies with good HRM departments are able to offer additional benefits to employees. With a good information system, they can offer cafeteria-style benefits where each employee selects a personal combination of benefits.

Small businesses have long complained about the burdens imposed by government reports and data collection. To alleviate some of the hassles and expense, several companies specialize in automating the data collection and report writing. Consider payroll: Because of the constantly changing laws, many companies rely on an outside agency to collect data and print the paychecks. One of the largest providers is Automated Data Processing (ADP). Even if a company chooses to maintain its own payroll records, it typically purchases the software from a third party instead of trying to keep up with the annual changes using internal programmers.

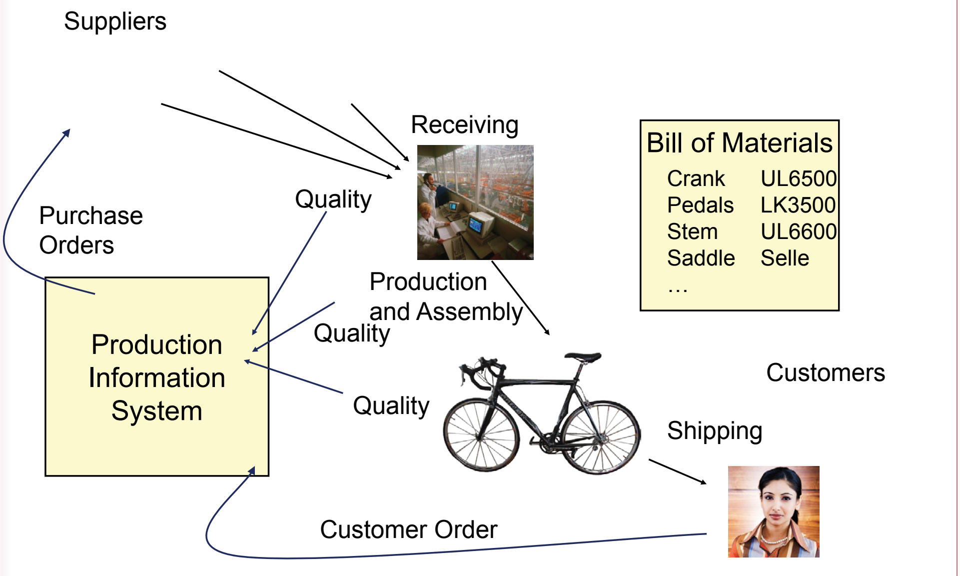


Figure 6.16

Production management. Production of goods and services generates considerable information. Purchase orders are placed with suppliers, internal documents like the bill of materials record production, shipping invoices record interactions with customers. Quality control measures are recorded at several steps in the process.

Several companies sell software that automates HRM data handling and produces government-required reports. From economics to equal employment to OSHA reports, the basic HRM reports are being computerized. You still need to collect the data in the proper format and convert it to the purchased software. In addition to saving time in producing reports, the packages often contain the essential government rules and can analyze the data to spot potential problems.

Some newer technologies are being used to simplify data gathering. In particular, companies are searching for ways to make it easier for workers to deal with the HRM department. A system created by PRC, Inc., uses touch-tone phones and a voice-response system to enable workers to make changes directly to their base information, like changing their address or tax withholding. Another approach is to install PC-based kiosks and use the Internet, so that employees can look up information, sign up for training classes, or modify their personal data whenever they wish. Other companies are using similar software and the corporate network to allow workers to perform basic HR tasks from their desks or from home using the Internet.

Production Management

Can a company become more efficient and productive? Sometimes this question is easy to answer—if you have been losing money. But perhaps you are manager of an organization that has been successful and profitable. Many companies have been successful for years and continue to operate the same way they always have. This practice might not be bad in every case, but the concept of **continuous quality improvement** dictates that you should always look

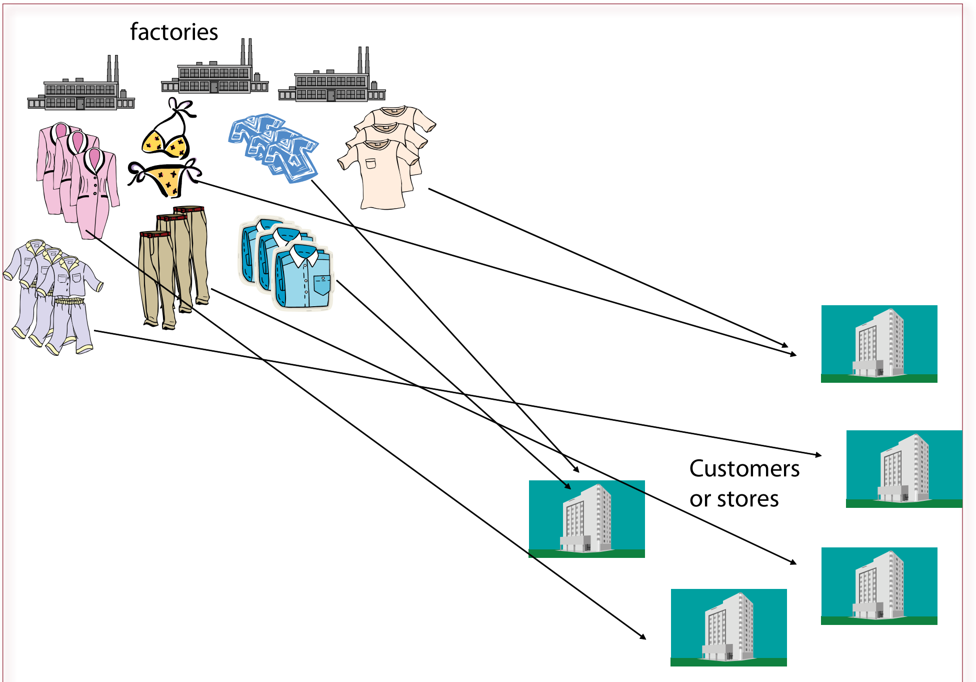


Figure 6.17

Production challenges. Multiple factories produce many items that are shipped to hundreds of customers. How do you schedule efficient production? How do you ensure the right products go to the correct locations?

for improvements—no matter how successful you have been. New production and information technologies are introduced continuously. Any one of these technologies might give you the ability to leapfrog your competition, or it might give your competitors the ability to squeeze you out of the market.

As shown in Figure 6.16, information technology has several important uses in production management. It is important to track orders, shipments, and all steps in the production process. The **bill of materials** is an important concept in manufacturing. It records the components that were used to manufacture a finished product. Data on it is used to trigger deductions in inventory of parts and signal the addition of the final product to finished inventory. These actions impact the accounting ledgers, so recording the proper amounts and time is important. Similarly, quality control measures are taken at several steps in the process—particularly with the receipt of supplies and the shipment of finished products. Detailed quality measures during the production process are used to identify processes, machines, and employees that need improvement.

Production Issues

Manufacturing in large scale presents several problems and issues to management. As shown in Figure 6.17, consider the case of a clothing manufacturer with several factories. Each factory can produce multiple items and the company works with many factories. The items are collected and shipped to hundreds or thousands of customers and stores. How do you schedule efficient production? How do you

Reality Bytes: Controlling Enterprises with BPM

In the early 2000s, New York Attorney General Eliot Spitzer filed lawsuits against several insurance companies for fraud and excessive fees. Politely stated, the entire industry appeared to suffer from poor management with limited knowledge of how fees were collected and disclosed. Integro Insurance Brokers was founded in New York in 2005 with the idea of applying business process management principles and software to the industry. Christophe Marcel, enterprise software architect stated that "there were a lot of questions about transparency and disclosure of where fees came from. There has been an industrywide initiative for quality improvement processes… To do that effectively, you need BPM." Using tools form BEA Systems Inc, the company built client-services applications to provide up-to-date data on transactions, and enable executives the ability to monitor all of the processes. Harcourt Assessment Inc., a San Antonio-based developer of scholastic tests, is using BMP software from Savvion Inc. to manage the process of developing test questions, using the system to automate online processes for collecting and analyzing customer feedback.

Adapted from Heather Havenstein, "BPM Is Helping Firms Control Critical Business Processes," *Computerworld*, October 30, 2006.

ensure that the right products are shipped to the correct stores? These questions seem obvious, but they are critical. In the 1980s, the huge designer jean company Gitano self-destructed because it was unable to answer these two questions.

Obviously, information systems are a key component to the answers. But you need to make sure the processes are in place to collect the correct data in a timely manner. This data has to be available throughout the company so managers can monitor for problems and make the correct decisions. For instance, with only partial data, it might appear that a factory is idle, while complete data might show that it is scheduled to ramp up production as soon as supplies or new machines arrive. Collecting data in a manufacturing environment can be a difficult process. Most workers are busy trying to build products and are not interested in taking time to enter data into a computer. You need to define the processes and jobs to ensure that accurate data is also being recorded. You also need to automate as much of the data collection as possible. Some machines can transfer data directly into the information system, but often you need to assign the task to someone. This step is particularly important when things go wrong. You also might have to add bar-codes or RFID tags to products so they can be counted and recorded automatically.

Once you have accurate data, you can usually purchase tools or hire experts to analyze the production processes and find improvements. The field of production operations management has many tools and models to organize and optimize production and scheduling.

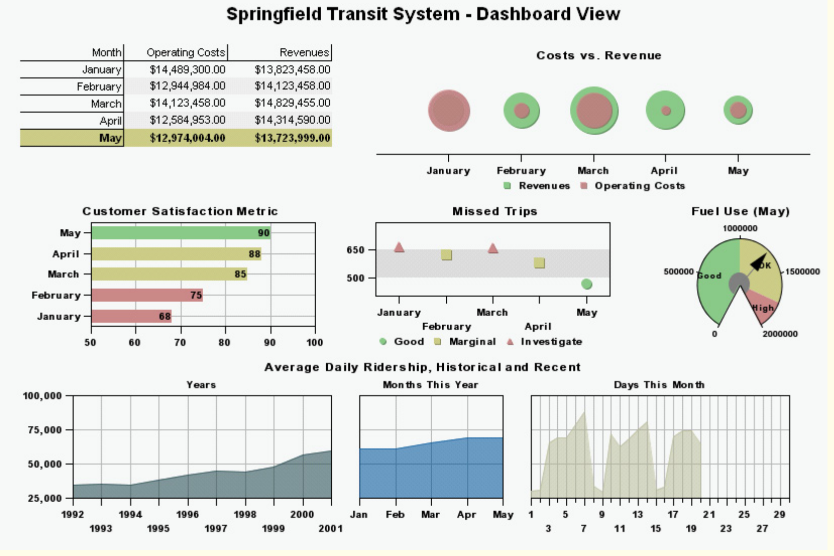
Distribution and Inventory Control

A key mantra in today's business is that you do not want to hold inventory. **Just-in-time (JIT)** production was designed to eliminate parts inventories held by manufacturers. Instead, suppliers are asked to deliver parts exactly when they are needed. In one sense, the process shifts the inventory onto the supplier, because the supplier is penalized if it is late with shipments. But, ultimately, it reduces the

Technology Toolbox: Designing an Executive Information System/Dashboard

Problem: How do you begin to understand the data collected by an ERP system?

Tools: Executive information systems or digital dashboards are designed to display summary data in real time. The systems usually begin by presenting a graphical overview using some primary measures of the organization. Executives and managers can quickly compare progress on key variables. They can then drill down and see more detailed statistics and even original transaction data such as orders.



http://www.visualmining.com/ncs/projects/Examples/PerformanceDashboard/TransitMetrics.jsp

An EIS can be a powerful tool to follow the progress of the company. Most ERP systems have some type of software that makes it relatively easy to extract data and create an EIS. However, one of the most difficult tasks is to identify the key items that need to be displayed on the main form. Across industries, companies vary enormously in the outcomes managers need to follow. Even within an industry, firms and managers rarely agree on what items are the most important. Consequently, each company needs to develop an EIS customized for its executives.

One approach to identifying the desired elements in an EIS is to follow the balanced scorecard method proposed by Robert S. Kaplan and David P. Norton. They recommend a complete analysis beginning from the top to identify the main strategic goals and derive measures that fit into primary categories. For instance, you would typically need measures on financial, customer, internal data, and learning and change. The top managers cooperate to identify the main indicators of each variable.

Quick Quiz:

1. Assume you have been hired to help a regional law firm. What key elements might go on the main EIS screen?
2. Assume you have been hired to help an airplane manufacturer; design the main EIS screen.
3. To help design an EIS for a retail video store chain, briefly describe the screens and steps needed to identify stores that are performing below par and find possible causes of the problems.

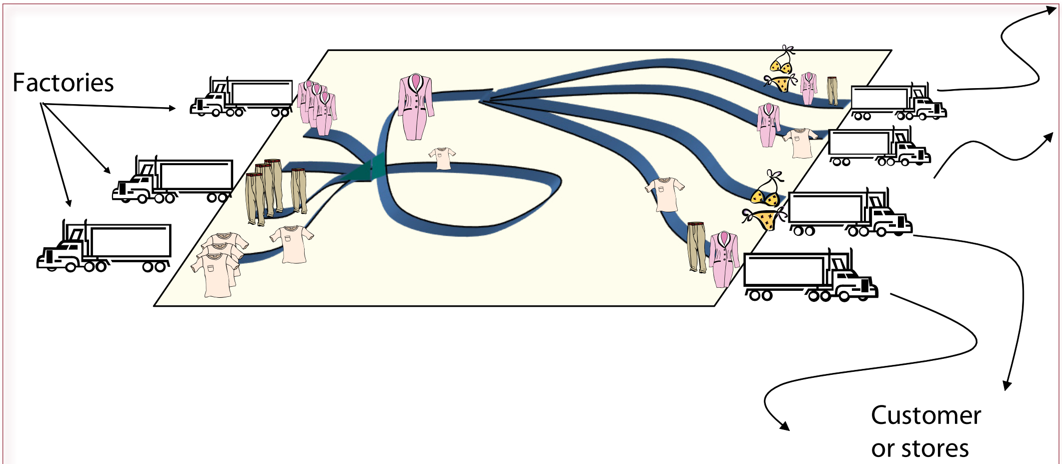


Figure 6.18

Distribution center. Factories deliver products in bulk to the DC. High-speed conveyors read bar codes on the incoming boxes to split the products into smaller shipments and route them to trucks headed for individual stores.

number of products held in inventory because everyone along the supply chain is interested in minimizing the value of the stalled inventory. Instead, everyone forecasts production needs and delivers products by keeping them moving through the supply chain.

As shown in Figure 6.18, the **distribution center (DC)** is an important part of a modern supply system. Incoming bulk shipments are unloaded from the trucks and placed on high-speed conveyor systems. Bar code readers in the center of the DC read each box. Outgoing trucks are matched to a specific customer and store. The computer reads the customer order list and routes the specified number of boxes of each item to every truck. When the trucks are loaded, they deliver the items to the designated customer and store. Additional savings are created by routing the same truck to the ship or rail yard freight docks to pick up an incoming bulk shipment. These trucks then deliver the bulk shipments on the left side of the DC in the diagram. Scheduling systems keep the trucks moving to maximize their capacity and to reduce deadhead or empty loads.

Distribution centers might be run by manufacturers, customers, or third-party transportation specialists. Wal-Mart is a leader in using the centers to reduce costs and deliver exactly the needed products to every store. Ultimately, you also need to match your shipment data against the customer receipts to ensure that your system is accurate and to compensate for shipping losses.

Integration in Business

How do businesses combine data from operations? The easiest way to understand the power of today's computer systems is to look at how integration has changed over time. Almost any organization has issues with integration. Consider a basic manufacturing company that has several production plants and sells into multiple markets. The managers need to track production data, costs, and quality from each plant. Figure 6.19 shows that they also track sales by region

	Production			
Plant	**Quantity**	**Quality**	**Costs**	**Prior Month**
Boise	260,721	9.6	$41,222,697	219,961
Decatur	171,371	8.75	$31,094,809	188,862
Yaounde	314,856	9.4	$29,119,967	406,859
	746,948	**9.25**	**$101,437,473**	**815,682**
		Wtd. Avg.	135.80	

	Sales		
Region	**Quantity**	**Avg.Price**	**S**
US East	225,091	$289.17	
US West	204,725	$273.20	
Canada	65,763	$192.00	
South Ame	67,495	$133.50	
Other	47,313	$169.00	
	610,387	**$211.37**	**$**

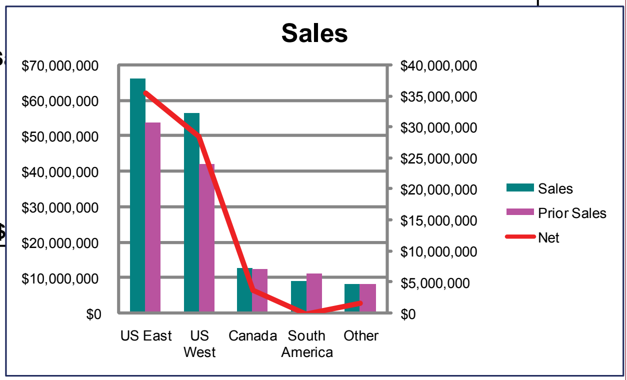


Figure 6.19

Integration with ERP. An ERP system can integrate almost all aspects of the company into one huge database. Either directly or through an executive information system, management can retrieve any report or piece of data by selecting options.

and use average costing to estimate net profits. ERP systems support considerably more complex analysis and integration across suppliers and customers as well as financial institutions. But the basic ideas are the same.

Assume that you are a manager responsible for producing the integrated report. You need to collect the basic data, perform some simple computations, create the report, and write a report for management discussing the results. The process of creating this report has changed considerably over time. Figure 6.20 shows the various methods by decade. It is important to understand all of the methods because it helps you appreciate the amount of work and steps processed by a modern ERP system. Also, companies are at different levels of development, so you could end up working for a company that uses any of these technologies.

In the 1960s and 1970s, computer systems were built for individual departments and areas within the company. In many companies, these systems became islands. They were focused on one task and did not share data with each other. For instance, the accounting department collected the basic transaction data and produced the necessary accounting reports. Anyone in the company who wanted to use this data relied on paper printouts of the standard reports. When spreadsheets arrived in the 1980s, the basic accounting numbers were often rekeyed into spreadsheets in other departments. Besides wasting employee time in retyping numbers that were already stored on a computer, this practice caused more errors from mistyping the data. Furthermore, consider that when the accounting department changes the numbers, some users of the data might not get the updated versions, and people would attempt to make decisions on the basis of outdated data.

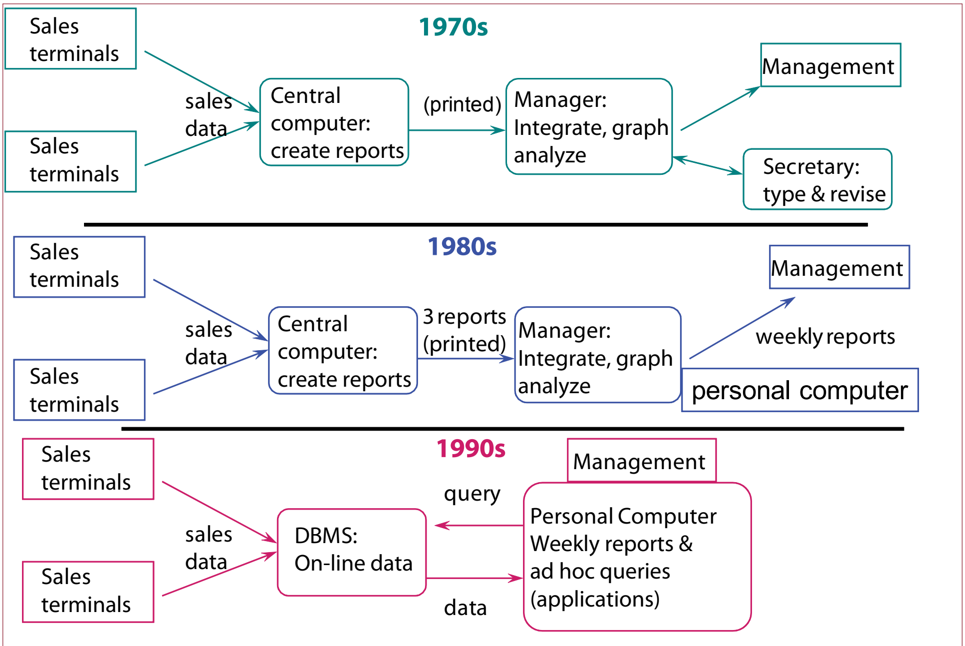


Figure 6.20

Middle management over time. The methods used to create integrated reports have changed over the past three decades. With simple transaction systems, managers computed the totals, drew graphs, and had secretaries type the report. With the adoption of personal computers, middle managers (or their secretaries) reentered the data into spreadsheets and used a word processor to print the final report. With an integrated system, top managers can use a personal computer to query the database, draw the graphs, and produce the final report.

Notice that in the 1980s, the clerical support was replaced with PCs. As a manager, you are expected to write your own documents and create your own charts.

In the 1990s, organizations began the steps toward integration. The basic transaction is stored in a DBMS, and networks provide access to the database. More important, this integration makes it relatively easy to create automated tools that extract the desired data, display results in charts, and enable managers to quickly find the answers to basic questions. To some extent, this type of system means that the company no longer needs you: the middle manager. You might be interested to know that this trend was predicted in 1958 (Levitt and Whisler, *Harvard Business Review*). It just took 20 years longer than they anticipated for technology to be developed.

As shown in Figure 6.21, in the first decade of 2000, even more powerful integration tools were adopted. The goal of these tools is to integrate all of the data in the company, including ties to suppliers and customers. Again, the entire system runs on a DBMS; the difference lies in its reach and its capabilities. Tracking customers and working closely with suppliers are increasingly critical functions in business. Just collecting the data and billing customers or paying suppliers is not sufficient. You need to be able to analyze and compare the data. Who are your best customers? Which ones cost you the most? Which suppliers provide the best qual-

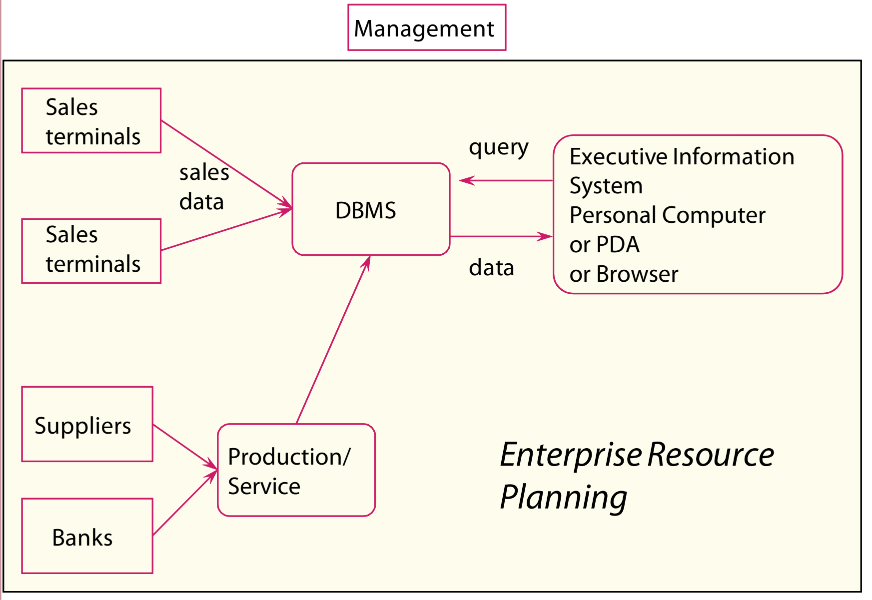


Figure 6.21

Integration with ERP. An ERP system can integrate almost all aspects of the company into one huge database. Either directly or through an executive information system, management can retrieve any report or piece of data by selecting options.

ity and are the most reliable? Answers to these questions can mean the difference between success and failure.

Enterprise Resource Planning

How do you combine data across functional areas, including production, purchasing, marketing, and accounting? **Enterprise resource planning (ERP)** is the current state of the art in integrated information in business systems. The systems incorporate data from financial accounting, logistics, and human resource management. The field is dominated by large, expensive software packages from companies such as SAP, Oracle, Lawson, and Microsoft Dynamics. The systems use databases, processes, and rules to provide up-to-the-minute data on the major financial issues in a firm. One of the key points of ERP systems is that they run on top of a DBMS; hence, all of the data is centralized and accessible via DBMS queries and reports.

As shown in Figure 6.22, ERP systems handle all of the financial accounting systems. They also emphasize purchasing, human resource management, and investment management. The systems are tailored for specific businesses and can focus on areas such as manufacturing, research and development, and retail sales.

One of the primary strengths of the ERP systems is that they were designed to handle data for large companies operating in an international environment. In the late 1990s, many companies chose to install commercial ERP systems, instead of trying to modify their existing systems to handle the year 2000 problem.

Computer use in most companies began with transaction-processing systems. Because transaction systems are structured and there is considerable experience at

Accounting
All transaction data and all financial reports in any currency
Finance
Portfolio management and financial projections
Human Resources Management
Employee tracking from application to release
Production Management
Product design and manufacturing life cycle
Supply Chain Management
Purchasing, quality control, and tracking
Customer Relationship Management
Contacts, orders, and shipments

Figure 6.22

Primary ERP functions. Each area has dozens of additional detailed functions. The real key is that all of the components are integrated. For example, any data entered into the HRM system is immediately reflected in the financial reports.

this level, it is a logical place to begin. However, it is also tempting to treat each transaction separately: (1) payroll services can be purchased from a specialized data processing company, so the data will be handled separately from the other corporate data; (2) a sales order-processing system might be constructed independently of the inventory control system; (3) process control systems to handle manufacturing tend to be isolated because the data (e.g., robotic control signals) are different from the data used in the rest of the company; (4) similarly, the corporate accounting system is often developed as a stand-alone product. Journal entries are created by copying data in reports produced by other systems. Although each of these transaction systems offers management advantages to their respective departments, it is difficult for managers to use data from other departments. Also, independent systems make it difficult for executives to share data and evaluate interrelationships between the departments.

The amount of data integration needed in a company often depends on the management structure of the firm. Some firms are highly decentralized, so that each business unit makes its own decisions and functions independently of the others. Typically in these situations, only accounting data (profit/loss) are integrated and reported to upper management.

On the other hand, some organizations are much more integrated. In your economics courses you were shown the difference between vertically and horizontally integrated firms. Consider a vertically integrated firm such as an oil company that functions at different levels of production (including oil exploration, drilling, transportation, storage, and retail sales). Although an oil exploration team may not need access to daily fuel sales in New York State, they do need to forecast future demand for oil. Likewise, the retail sales division does not need to know the daily costs associated with drilling for oil, yet they might need to track deliveries and communicate with the corporate office.

Consider a horizontally integrated firm such as Wal-Mart with retail stores in many different cities. It achieves lower costs by combining the buying power of all its stores. By coordinating sales, warehouses, and distribution, Wal-Mart can negotiate better prices with manufacturers. Moreover, Wal-Mart reduces operating costs by standardizing management practices (and information systems)

Reality Bytes: Paying for the Train

Long Island Rail Road trains do not accept credit cards. And the tiny train station in Amagansett in the Hamptons does not have ticket vending machines. Conductors will accept cash, but most young riders do not carry much cash. So they get a bill, which they might or might not pay. One rider, Renee Osgood, noted that "You don't always plan ahead to make sure that you have cash on you. I never really carry around cash, anyway." In response, LIRR president Helena Williams noted that the railroad is increasing the number of signs, asking riders to carry cash.

Adapted from Andrew Grossman, "Cashless Hop Rides on the LIRR," *The Wall Street Journal*, July 27, 2010.

across all the stores. By integrating information from all stores, it is easier for Wal-Mart to forecast customer demands. Also, by networking the store information systems, managers who experience higher sales of certain products can request shipments from stores that are not selling the item as rapidly.

Manufacturing firms can gain additional benefits from integrating data. Benefits like just-in-time inventory, total quality management, and mass customization can exist only with the tight integration of data. The National Bicycle Industrial Company of Japan illustrates how integrated data is used to provide customized products to mass markets.

International Environment

Several ERP features are important to firms operating in an international environment. First, all menus and reports should be available in several languages, so clerks and managers can use the language they prefer. Second, the system should handle currency conversion automatically, so managers can view reports in any currency. Similarly, conversions should be capable of being fixed at a point in time, so that when items are transferred, they can be valued at the exchange rate in effect at that time, even if the rate changes later.

A more complex feature for the international environment is the ability to produce reports following the rules of individual nations. For example, a company with subsidiaries in many nations would need to produce reports that follow the rules (e.g., depreciation) for each specific nation, and then produce consolidated reports following the rules of the home nation.

A third complicating factor arises from taxes. In addition to the rates, the rules and procedures vary by nation. The rules are particularly important for payroll and benefit applications. A good enterprise application automatically incorporates the rules for each nation and state.

Financial Accounting

The accounting system is a core feature of an ERP. Eventually, all transactions must be recorded in the general ledger accounts. The accounts fulfill the standards required by each nation. They are used to create the standard accounting reports. The systems provide flexibility by enabling managers to create their own subaccounts and subledgers, which are used to create reports on additional topics. An important feature of the accounting system is that standard accounting reports can

Reality Bytes: Marin County ERP

County governments perform many tasks that are similar to common businesses. ERP software exists for government agencies, but it typically must be heavily customized. In 2006, Marin County in California signed contracts with SAP and Deloitte Consulting to build a new ERP system to replace the old legacy system. By mid-2010, Marin executives were unhappy with the system and filed lawsuit against Deloitte Consulting, claiming that only 50 percent of the functionality is available and working. David Hill, director of the county's IT services department argued that "In order to make it happen with SAP, we would need to re-architect it, redesign it, and that would be quite expensive." The budget analysis estimated fixing and supporting the SAP system would cost at least $34.7 million over the next ten years; which starting over with a new tool would cost $26.2 million.

Adapted from Chris Kanaracus, "Marin County to Rip and Replace Ailing SAP System," *Computerworld*, August 24, 2010.

be generated at any time for any section of the company. The ERP system automatically uses the most up-to-date data.

In addition to standard financial accounting, the systems manage assets and provide common treasury functions such as cash management. The systems also provide basic audit trails and other accounting controls. To make them easier to use, most ERP systems provide enterprise (or executive) information system (EIS) capabilities. Managers can examine data at virtually any level of detail. From summary values, they can drill down to more detail.

Logistics

Logistics consists of the operations required to purchase materials, deliver them to the warehouses and factories, and sell and distribute products. It incorporates traditional MRP analysis, quality control, accounts payable, and accounts receivable.

In today's manufacturing companies, logistics is an important component of just-in-time inventory and demand-driven production. Using an integrated system, the marketing department gets up-to-the-minute data on customer demands. Marketers can cooperate with designers and engineers to develop new products. The specifications can be transferred to the production machines and raw material orders can be generated for vendors. Purchasing and payments can be tracked and generated over EDI networks—including the Internet. As orders are generated and inventory levels change, the accounting data is automatically updated—providing instant analysis of profitability.

For service-oriented companies, logistics involves service management tasks. The ERP systems can track customers, identify repeat customers, monitor service contracts, help salespeople with call management, and handle automatic billing and accounts receivable issues.

Human Resource Management

Payroll is a complicated function, particularly in a multinational environment involving different rules and currencies. Even in a single state, the issues of benefits, state and federal rules, and legal issues arising from child support make handling payroll a complex task.

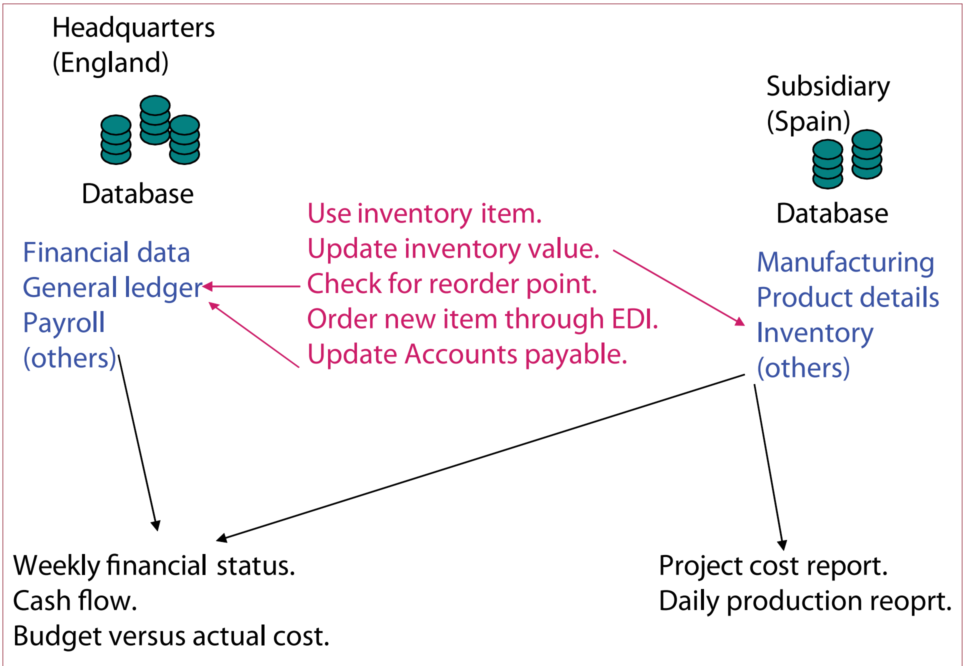


Figure 6.23

ERP integration. Although data can be distributed, it is still integrated across the organization. Changes in one item (inventory) cause changes in all related databases. Reports are generated from current data.

Today's HRM departments handle such additional tasks as recruitment, training, travel, and organizational planning. Each step must be documented and requires a variety of federal and state reports. In addition to these basic tasks, most of the major ERP systems enable HRM departments to offer Web access to basic data. For example, employees can use the Web to check on their taxes, change their withholding status, and sign up for benefit plans and training sessions.

Integration

Integration is probably the most important feature of the ERP systems. All the data is stored in a central database; hence, data is entered only one time (but into a double-entry accounting system). All reports are generated from the base data. Custom queries and reports can be generated through the DBMS.

Consider a simple example. A manufacturing plant takes an item from inventory. The system instantly adjusts the inventory quantity on hand. It also updates the financial value of the inventory holdings on the general ledger and any subledgers that utilize that figure. New orders can be triggered automatically with the orders and payments sent through common EDI mechanisms. All of the changes are made automatically. When managers request reports, the new data is automatically incorporated and displayed using current currency conversions.

The key point to remember is that all of the transactions and accounts are integrated. Managers can request reports by using any combination of data at any time—and each report will use the most up-to-date information.

Reality Bytes: Applicant Tracking

About 61 percent of North American companies use applicant tracking software to scan and sort job applications. According to a survey by HR research firm Bersin and Associates, even small and mid-sized businesses have begun adopting them. The firm notes about 55 different vendors sell applicant tracking system (ATS) software. The largest vendors include Taleo, silkroad, Oracle, iCIMS, Lumesse, and Kenexa. Job applicants use a Web site to upload a resume which is then scanned for key words and routed to the appropriate location if it finds enough matches. An interesting aspect to the software is that many of them do not fully support PDF files. So job applicants should typically submit a resume in Word format.

Adapted from Kelly Eggers, "Resume Debate: Word v. PDF," *The Wall Street Journal*, May 25, 2011.

Most of the major ERP systems also utilize distributed hardware and software. Hence, the database can be split into many pieces stored in different locations. As changes occur in one location, they are automatically distributed across the network to the other locations. The company can add a subsidiary with its own processing support. Yet, all of the new data is readily accessible to managers throughout the company.

Figure 6.23 provides a simple example of data integration. When a factory uses an inventory item, the system reduces the current inventory count. It also changes the inventory valuation in the general ledger. The item usage might trigger a purchase through the EDI system, which must also be recorded—along with the accounts payable change. Since the databases are shared across the organization, all changes are automatically included when new reports are generated.

Remember that all of the modules are integrated. So manufacturing schedules developed in the production module automatically provide data to the payroll system and personnel systems. Then the financial data (e.g., wages) is linked back to the general ledger, which provides updated data for all financial reports.

One important catch with an ERP system is that it requires changes to the way the company operates. In many cases, these changes can be good—for example, it forces everyone to follow the standard accounting procedures. In other cases, the ERP is too inflexible and interferes with the way the company operates. Managers have to carefully evaluate the trad-eoffs of integration and flexibility.

Supply Chain Management

How do you make production more efficient? Supply chain management (SCM) concentrates on the production side of ERP. It begins with logistics (purchasing and receiving components), through manufacturing configuration, and into distribution of the products. As shown in Figure 6.24, these factors involve a significant portion of the company, requiring integration of a huge amount of diverse data.

The key to understanding the value of SCM is to go back in time again to see how manufacturing evolved. From the 1920s through the 1970s, companies in many industries recognized the importance of economies of scale or mass production. The automobile industry presents the classic example. Producing thousands

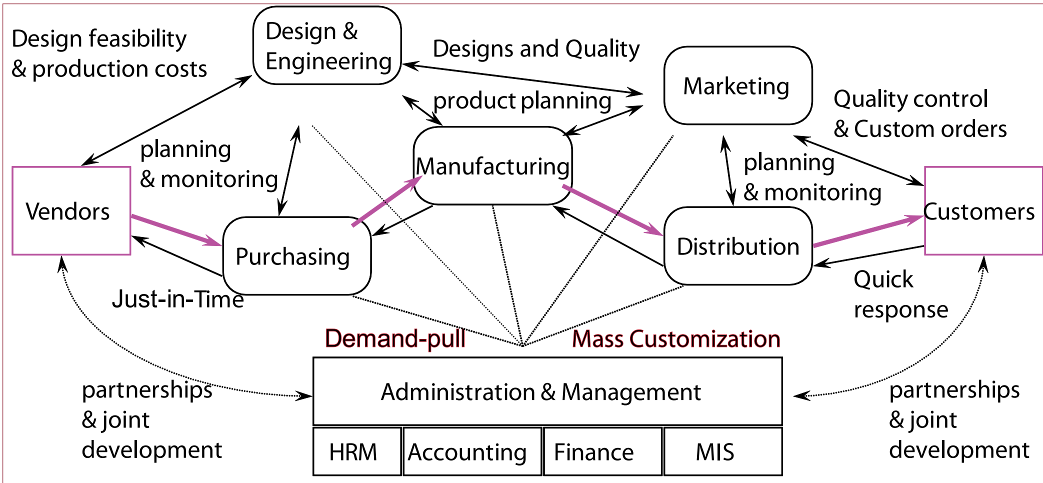


Figure 6.24

Total data integration begins with the vendors, tracks data through all operations of the firm, and incorporates information from customers. Each area in the firm has easy access to data from any other location. This integrated data is used to make better decisions by enabling managers to focus on the big picture instead of on local solutions.

of identical cars enables the company to spread the huge fixed costs across a large base—leading to lower average costs. The huge scale enabled the car companies to negotiate better prices with suppliers and dealers, reducing costs even further. So, in the name of lower costs, the companies produced thousands to millions of identical items. They relied on the marketing departments for two critical purposes: (1) forecast consumer preferences in advance, and (2) convince consumers they need the products that were built. So, the car salesperson says, "Sure, we could order a car for you, but it will cost more and take months. You would really be happier with this car and you can drive it home today."

Of course, mass production has the potential for mass disaster. If you predict incorrectly, or cannot convince customers to buy the existing product, you end up dumping the products at sale prices. Remember that you have to clear the way for next year's models. More critically, mass production means that it is impossible to please all of the consumers—leaving a niche open for your competitors. A niche in the small-car market enabled Toyota to become one of the largest producers in the world.

SCM Changes the Focus

So how does SCM help? It can change the entire system. Mass production begins at the supply side and builds products as cheaply as possible to eventually sell to consumers. With a truly integrated supply chain, it is possible to start with the customers. The marketing department identifies exactly what each customer wants. The customized orders are entered into the system, and the engineering department evaluates the order, makes design changes as needed, and schedules production. Manufacturing knows each desired production date and organizes products to minimize production costs. Component orders are placed with suppliers electronically. On the day of production, as components arrive, they are scanned into the system and routed to the appropriate location. At the same time, payments are scheduled with the banks. As the parts arrive at each machine, the central process controller configures each machine correctly as the product moves through the assembly line. At the end of the production line, the product is labeled and shipped to the appropriate customer. The customer can be notified electronically and billed automatically.

Imagine how much easier it is to be in marketing now. Instead of convincing customers to buy what you have produced, you first find out exactly what they want, and that is what you sell them. It is not quite that simple, but at heart, that is the principle. **Mass customization**.is the process of manufacturing products designed for specific consumers but using mass-production techniques to keep costs low. It can be done only if you have an integrated system. In many cases, it is not possible to produce exactly what the customer wants (after all, most customers want the world for free). And sometimes you have to produce for groups of similar customers instead of a single consumer, but the principle is the same—use the integrated technology to provide as much customization as possible. For example, it might never be possible to produce a truly customized automobile economically, but customers might be satisfied with more choice of options.

JIT production is an example of how integrating information can change a production process. Japanese manufacturers created this method with low-tech *kanban* signals that conveyed information along the production line to the suppliers. Today, ERP systems can provide immediate information from all stages of production. This information can be made available to suppliers so they can schedule deliveries. The overall goal is to reduce production costs and eliminate bottlenecks by reducing the need for huge inventories.

SCM Challenges

SCM and integration are powerful tools. You might expect all firms to be using them heavily. But SCM has two serious obstacles: (1) cost and (2) establishing connections and agreements with outside firms. The issue of cost can be overcome—although the tools are expensive, if they can save enough money, the cost is acceptable. But that explains why smaller firms with fewer purchases might not be able to afford the technology. The second issue of building connections across multiple firms is far more difficult.

A key issue in SCM is connecting to suppliers electronically. It can also require connections to distributors and transporters. Each of these hundreds of companies could have different hardware and software. Plus, all companies involved have to worry about security issues. Sharing data is a more difficult problem than simply blocking all access. B2B e-commerce is an interesting solution proposed to solve some of these problems. In the late 1990s and early 2000s, several B2B auction sites were set up to coordinate purchasing and tracking of products within an industry. For example, Covisint was established by several automobile manufacturers to handle transactions for automobile components. Few of these electronic auction sites survived the dot-com crash. However, some are still supported and used in major industries, such as automobiles and steel.

To a typical consumer, purchasing seems like an easy process: you find a product and buy it. As shown in Figure 6.25, the reality is considerably more complex. Consider the purchase of a new item. First the buyer has to identify the purpose and individual features desired. Then the buyer identifies potential suppliers and

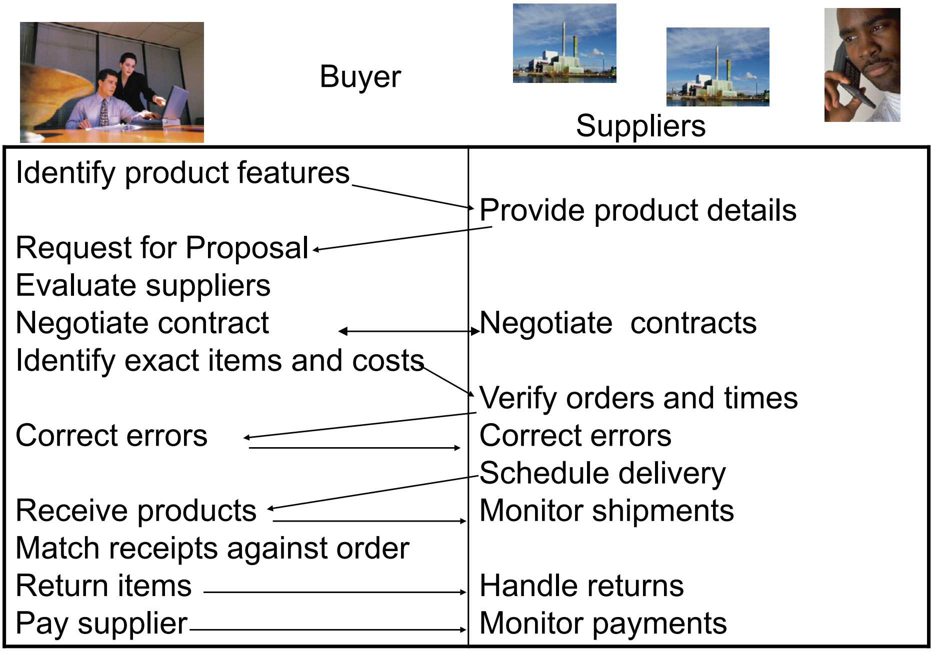


Figure 6.25

SCM Purchasing. Purchasing is considerably more complicated than it appears. It often requires several interaction steps with suppliers—even for existing relationships. Monitoring prices, quality, and timeliness is critical to both sides.

sends a **request for proposal (RFP)**. The suppliers select products that match the desired features and make proposals and bids for the sale. The buyer evaluates each request, selects a supplier, and negotiates a contract. From this point, the process is similar, even for repeat orders. The buyer generates a list of specific products, prices, and quantities, along with a desired delivery date. This purchase order is sent to the supplier, who verifies the orders and checks to make sure products are in stock and available for delivery. Any problems with prices or delivery times require notifying the buyer and negotiating changes. Eventually, the products are shipped to the buyer along with an invoice detailing the items delivered. Of course, the buyer has to verify the quantity and quality of the items received. Any discrepancies are recorded and the seller is notified. Some items are returned. Ultimately, the seller sends a bill to the buyer detailing the amounts owed. On the accounting side, the appropriate accounts payable entries have to be made. Finally, the supplier has to be paid, and needs to monitor receipt of payments and match them against the bills.

One goal of an ERP system is to automate as many of these tasks as possible. Figure 6.26 shows a version of an ERP screen for a buyer or product planner. Other screens enable suppliers to connect and electronically pick up purchase orders or check on the status of deliveries and payments. All data is entered into a shared database. From the buyer's perspective, notice the scorecard that quickly indicates the status of several key variables. Additional tools on the page enable the buyer to check on the current inventory status of individual products. For example, he

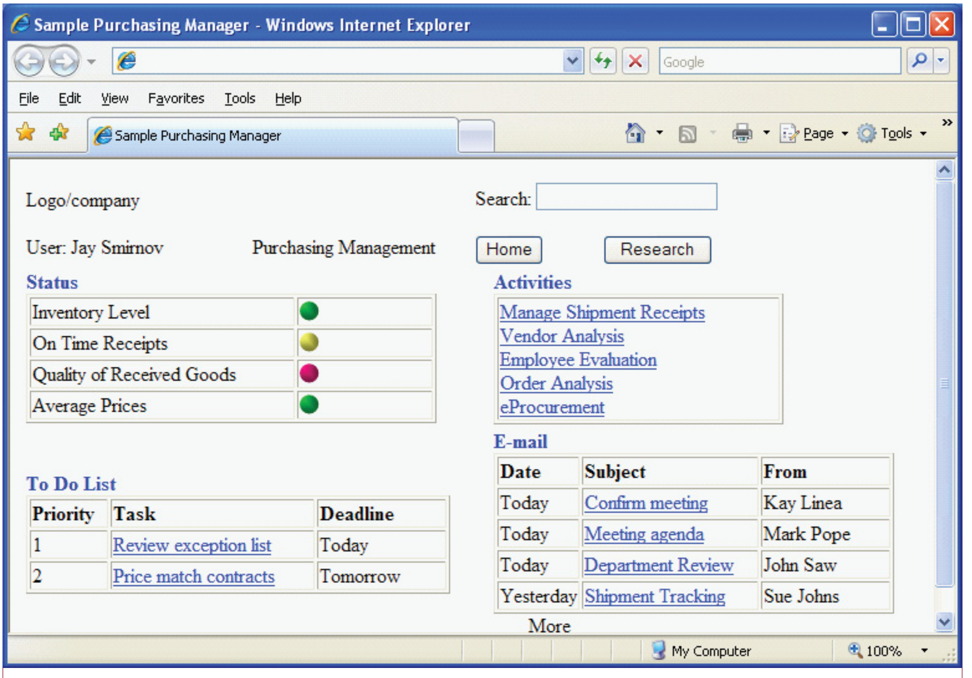


Figure 6.26

Purchasing manager perspective. Notice the scorecard to indicate important performance variables. This portal page includes links to tools that help manage day-to-day tasks.

can quickly see if the company has too many items in stock for a particular product. Additional tools provide the ability to examine payments, shipments, problems or exceptions, and perform analyses on vendors and products.

Integration across Systems

The buyer-seller relationship points out a major challenge that remains to be solved: how do you exchange data electronically between buyers and sellers? Today, both the buyer and seller probably have ERP systems, but they might be from different vendors. Even if they are from the same vendor, they might not format data the same way. So, the buyer will ask the seller for a person to log in and check on the supplier data. Similarly, the seller will ask the buyer to log in and use its system.

The major work in the 2000s by the ERP vendors has related to connecting systems and sharing data electronically. XML is one tool that was established to help companies exchange data. As shown in Figure 6.27, ideally, each company would implement an interface that would accept and read XML documents sent from its partners. The machines could quickly parse the documents and transfer them into the required internal format. Internal functions could then schedule deliveries, check on shipments, or transfer payments. All of the data within an XML document is in a specified format and tagged so that a computer program can quickly read the file and identify the data and its purpose. Several companies, including IBM and Microsoft, are developing technologies to use XML to make it easier to share data across companies.

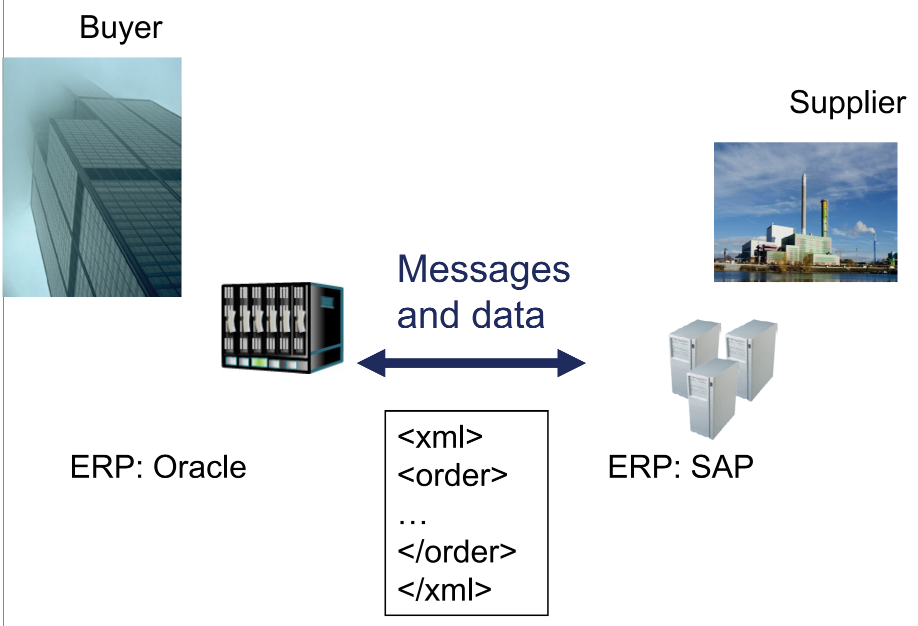


Figure 6.27

The role of XML. XML is used the transfer messages to diverse systems. Each system contains tools to read and write XML documents and convert the data into the appropriate internal database tables.

Customer Relationship Management

How do you keep track of all customer interactions? Who are your best customers? Although customers are important to all businesses, the Internet and wireless applications add new dimensions to managing customer relationships. One problem is the expanding number of customer contact points, from sales representatives, to call centers, to Web sites, and wireless connections. Customers expect merchants and suppliers to remember actions and decisions that were made earlier—regardless of the method of contact. Consequently, companies need integrated systems that instantly provide all details of customer contacts. The new technologies also provide innovative methods to keep in touch with customers and identify their specific needs to sell additional products and services. Several software tools have been developed to improve **customer relationship management (CRM)**. Most ERP systems have added (or purchased) CRM systems to provide an integrated contact and sales management system.

Multiple Contact Points

One of the greatest challenges facing a company today is the multiple sources of contact points with customers. Most of the original systems designed to handle these interactions are separate. Salespeople often keep their own records, Internet support systems may not be totally connected to the sales fulfillment centers, and faxes are rarely integrated into the online customer files. But customers assume that when they talk to one person, that person has records of all the prior interactions.

Reality Bytes: Customer Relationship Management at Dow

Most people do not think about the mundane tasks that computers handle—such as sorting data. Computers have been doing it for so long, that it is taken for granted. And sorting is relatively standard—for small amounts of data. But sorting large amounts of data is definitely not trivial. In 2010, computer scientists at UC San Diego set a world record for sorting when they were able to sort one terabyte of data in 60 seconds. A full minute seems like a long time to wait for a sort, but a terabyte is a ton of data to move around. The task required 52 computers with dual quad-core processors and 24 gigabytes of RAM, plus 16 500 GB disk drives. The team also set a record for the fastest data sorting rate. The system sorted one trillion data records in 172 minutes (almost three hours). Alex Rasmussen, the lead graduate student on the team noted that "Sorting puts a lot of stress on the entire input/output subsystem, from the hard drives and the networking hardware to the operating system and application software." Many business transactions and reports require sorted data, including search results and product recommendations.

Adapted from Daniel Kane, "Data World Record Falls as Computer Scientists Break Terabyte Sort Barrier," UC San Diego News Center, July 27, 2010.

At first glance, it appears that it would be straightforward to build an integrated application to hold all customer interaction data. Of course, it would be a lot of data and would take time to build the application. But the real challenge lies in getting everyone to enter all of the data. Consider the situation of a salesperson who has invested time and collected substantial data on product preferences and customer work environments. That information gives an advantage to the salesperson. Why would the salesperson be willing to share it?

Customers with multiple divisions and many different product tracks also add complications to CRM. The system has to be able to track transactions, questions, and issues by a variety of factors (date, product, company, person, and so on). The system also needs a sophisticated search routine so users can find exactly the pieces of data required.

Feedback, Individual Needs, and Cross Selling

The main purpose of CRM systems is to provide individual attention to each customer to improve sales. By tracking prior purchases, you understand the status of your customers. By providing new channels of communication, you improve the ability of customers to provide feedback to comment on products and services and to make suggestions for improvements. By identifying patterns in purchases, you can develop new ideas for cross selling. If a group of customers tends to purchase several products, you can search the CRM database to find customers with only part of the solution and have your salespeople demonstrate the advantages of the entire suite—using the other customers as examples and references.

The flip side to CRM is that collecting and coordinating substantial data about the customer can lead to privacy problems. As long as the data is secured and used internally, few problems arise. But firms still need to be sensitive to customer wishes about unsolicited contacts. In fact, customer privacy requests need to be part of the CRM system. The issues are more complex when the selling firm has multiple divisions, and each one wants to push new products to existing custom-

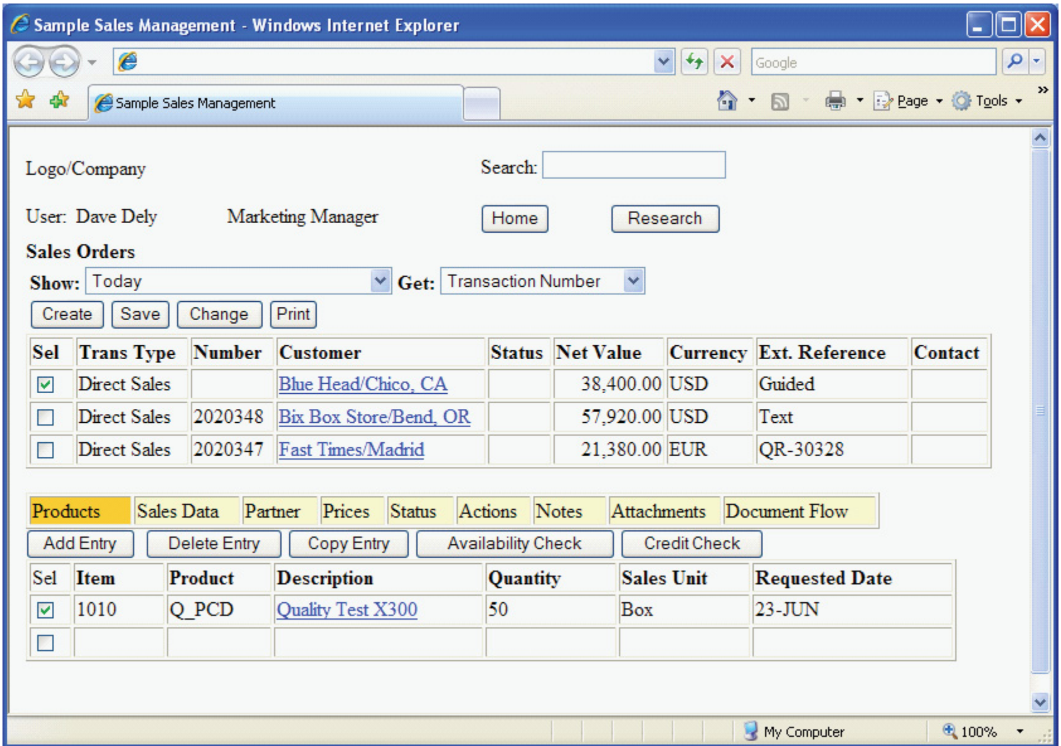


Figure 6.28

Sales and CRM from a sales manager's perspective. Keeping all the customer interaction data in one location makes it straightforward for the salesperson to understand all of the company's associations with each customer.

ers. The marketing staff needs to use the CRM system to coordinate and monitor all contacts.

Wireless applications provide even more options for CRM. Your salespeople can stay in constant contact with the corporate database. They can retrieve current shipping status or detailed customer information during a sales call. They can forward questions or comments, which can be analyzed and answered immediately.

CRM Packages

ERP systems often have a CRM component that provides a unified view of customer data. For example, as Figure 6.28 shows, sales managers can quickly check on the status of customer purchases, returns, or any other transaction involving customers. When salespeople call on customers, they need to be able to quickly retrieve all of the recent transactions with that customer. Perhaps the customer had problems with a recent shipment, or perhaps they just placed a new order. The salesperson can review those activities before calling on each customer. Then the salesperson can investigate any problems or check on current status and provide immediate answers to customer questions. One of the biggest challenges with a CRM system is collecting the necessary data. An ERP system will have all of the basic transaction data—from the perspective of the main company. But will salespeople enter all of their personal data into the system?

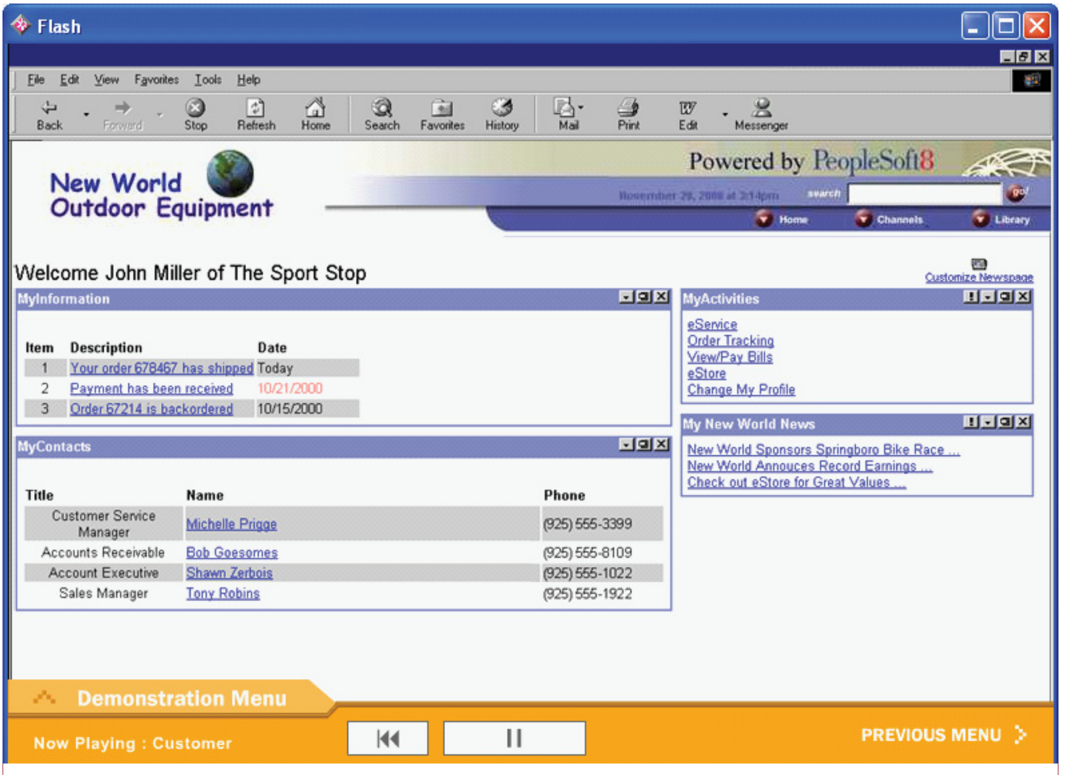


Figure 6.29

PeopleSoft CRM from a customer's perspective. The portal into the ERP system enables customers to check the status of various items, order new products, and contact the company.

Another important aspect of CRM is the ability to provide direct customer service. As shown in Figure 6.29, ERP systems have self-service portals that enable customers to check on order status, pay bills, order new products, contact salespeople and account managers, check on company news and events, or ask for additional help. Although the page does not directly support XML, it does make it easy for customers to check on various transactions 24 hours a day. By encouraging customers to connect directly to your system, you obtain more accurate data and reduce costs. Of course, if your customer is the 800-pound gorilla in the industry, it is more likely that your salespeople will be spending time on the customer's ERP site.

Summarizing ERP Data

How can a manager handle all of the data in an ERP system? ERP systems result in huge databases containing an enormous amount of data. Since the data represents all aspects of business transactions, it contains incredibly valuable information needed to make key business decisions. But, as a manager or executive, how do you find this information? Since it is stored in a relational DBMS, you could write queries to retrieve data. But, after a little time, you will see that you often need the same data every day—so you can compare the prog-

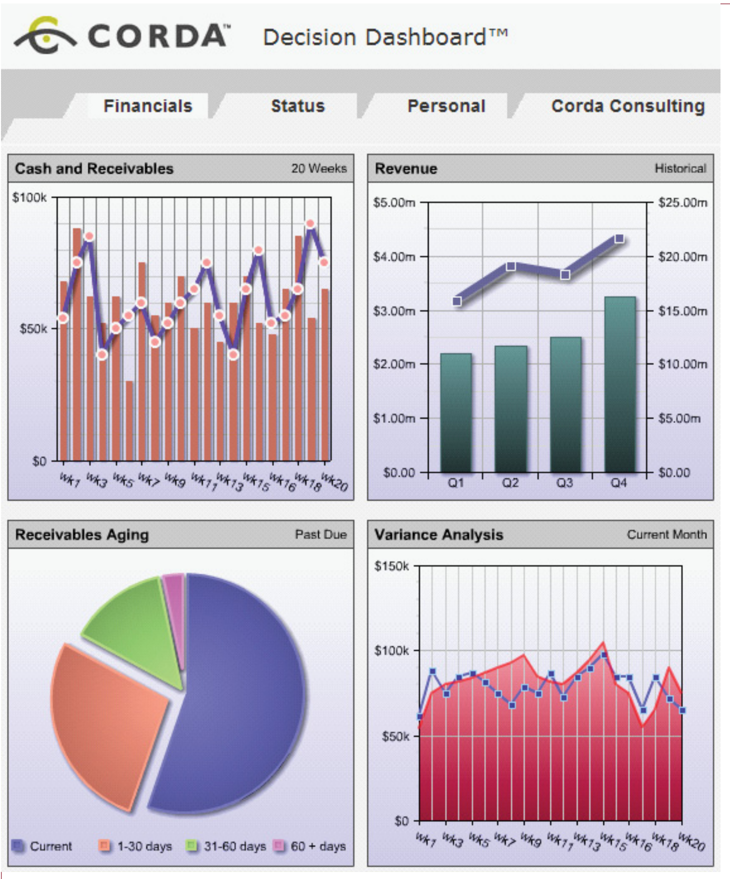


Figure 6.30

Digital dashboard example. Like the gauges on an automobile dashboard, the digital dashboard presents a top-level graphical representation of the status of various elements. Managers identify variables and choose from charts, gauges, icons, and tickers to display the data. Each item should be selectable to drill-down and provide more detail.

ress of common items. Consequently, many ERP systems have special tools to retrieve this standard data and display it in a graphical format.

Digital Dashboard and EIS

One of the major challenges to any information system is to make it easy to use. This process is complicated because the decisions need to be provided to upper-level managers who have little time to learn complex applications, yet deal with huge amounts of diverse data. One approach is to build a portal that displays key data and graphs on one page. The page retrieves data from a data warehouse, the Internet, or even machines within a factory and displays graphs and warnings. Toolkits exist to help build this **digital dashboard**. The older term for this approach is an **executive information system (EIS)**. Figure 6.30 shows a sample digital dashboard that with various charts designed to provide a quick overview of several key functions.

Reality Bytes: Cash is No Longer King

In the U.S. the Federal Reserve System is in charge of issuing and controlling cash. A study on the stock of small-denomination bills in use indicates that the use of cash reached a peak in the mid-1990s. Between 1995 and 2006, noncash transactions had increased from 250 a person to more than 300. Much of the shift has been to debit cards. But, it has been difficult for small vendors (or friends) to accept payments with cards—particularly without a storefront. A few companies, including PayPal, Intuit, and Square are trying to make it easier for people to make small payments without cash. For example, Square has a small credit card reader that plugs into the earphone jack of an iPhone or iPad. Processing costs for credit cards are relatively high and sometimes require monthly contracts. Square relies on per-transaction costs of 15 cents plus 2.75-3.5 percent of the transaction value. Apple and several other companies are trying to find new ways to transfer money. But any mechanism must be supported by both customers and vendors.

Adapted from Claire Cain Miller and Nick Bilton, "Cellphone Payments Offer Alternative to Cash," The New York Times, April 28, 2010.

Much like the dashboard on a car, the purpose of the main screen is to provide an overall picture of the status of the firm or a division or production plant. Managers can select the specific division and make comparisons to yesterday, last week, last month, or other locations. If there is a problem or a decision to be made, the executive can **drill down** to get more detailed data by pointing to another object. For example, if the main screen shows that current sales in the west region are low, the executive can focus on the west region and bring up the last few quarters of sales data. The EIS will graph the data to highlight trends. The manager can then dig deeper and bring up sales by departments or check the sales performance of each employee, highlighting unusually high or low sales figures. By pointing to customers, executives can get current profiles on the main customers and examine their recent purchases.

How Does an EIS Work?

For an EIS to work, it must be connected to the transaction-processing system or data warehouse, since it is the source of the data. Many of these systems are created with special software that simply grabs data from the corporate databases. In one sense, the EIS is a complex model of the firm. Figure 6.31 illustrates how executives can "visit" different divisions on the computer and retrieve the data immediately. For the EIS to be useful, the computer model must be a faithful representation of the actual company.

As a model, the EIS display has inputs of raw materials and people. Outputs are typically measured by traditional accounting standards of profits, costs, and growth rates. The EIS maintains budgets and forecasts and can compare them to actual values. The functions and processes are determined from the individual departments. For instance, there could be a production model that describes the manufacturing output. An EIS at McDonnell Douglas has a graphics screen that displays portions of airplanes as they are being built. As a wing is completed, it is drawn onto the computer model.

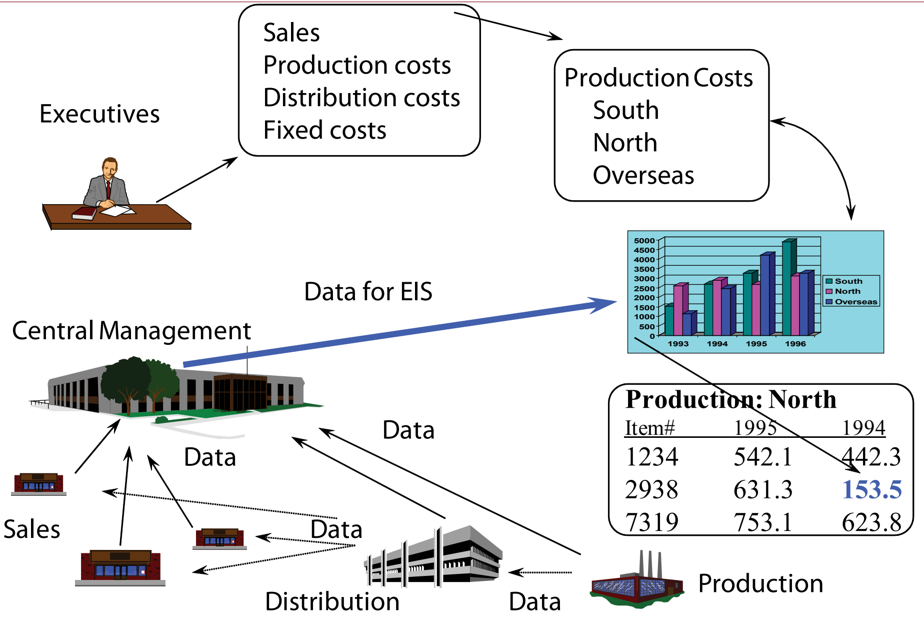


Figure 6.31

Executive information system. As industries become more competitive, managers search for ways to evaluate and improve the overall operations. Enterprise systems collect data from across the firm and make it available to managers and top executives. Executives can start with an overview of the firm and drill down to various levels and departments to get more detailed data.

Advantages of an EIS

The primary goal of an EIS is to provide easy access to corporate data for the executives. Instead of waiting for a report, the top executives can retrieve the data as soon as it is available. Also, because all the data is accessible from the same system, it is easier to examine data from different departments to produce a better view of the big picture. Another useful feature is that the executive's use of the data is nonintrusive.

Imagine that you are CEO of a company, and you do not have an EIS. The monthly reports have just indicated that one of the warehouses is not running smoothly. You want to find out what the problems are. You suspect the warehouse manager is part of the problem, but you need to be sure. What do you do? The most direct approach is to go visit the warehouse. But what happens when you show up at the warehouse? It is likely that the manager and the workers will change the way they work. Your attempts to collect data have altered the way the system runs, so you will not get the information you wanted.

Other options include sending other people or asking for additional information via the chain of command. Although useful, these methods will be slower and the information you receive will be colored by the perceptions of the people collecting the data. For example, many people will try to focus on what they think you want to hear.

Reality Bytes: Debit-Card Fee Cut

Overall, banks are in charge of the debit card and credit card systems. Technically, MasterCard and Visa are now independent companies, but they were created as agents of the largest banks to handle processing for credit and debit cards. Retailers who accept the cards pay fees to use the cards. In the U.S., fees for debit cards averaged from 1-2 percent of the transaction cost. These costs added up to an estimated $20 billion a year for U.S. merchants. And they were about twice as high as in Europe and other nations that regulate the fees. In 2010, Congress passed a law to limit the bank interchange fees charged for debit card purchases. The law took effect in July 2011 and essentially cut the fees in half. Banks expressed concern about losing a revenue stream and searched for ways to cut customer reward programs and increase other fees. Merchants would gain through lower costs and could either reduce prices or increase profits. Most economists were betting merchants would keep the extra profit.

Adapted from Miguel Bustillo, "Merchants Win Debit-Card Fee Battle," *The Wall Street Journal*, June 20, 2010.

The EIS minimizes these problems by providing instant access to the corporate data. The executives can produce reports and examine departments without interfering with the operations of the company. Graphs can be created automatically. The executives can set up different scenarios or simulations. Most of these activities are accomplished simply by pointing to objects on the screen.

Transaction Accuracy: Sarbanes-Oxley

How does the CEO know that financial records are correct? After several huge corporate scandals in 2001 and 2002 (Enron, Worldcom/MCI, Tyco, and so on), Congress decided to try and stop some of the problems. In particular, high-level executives were pleading innocent claiming that they did not know about the problems. So, they passed the Sarbanes-Oxley Act, which requires top executives of public companies to sign a statement attesting to the validity of the annual financial statements. So, how does the CEO know if the transaction data and reports are correct?

The solution proposed by the accounting standards board (AICPA) is to require more independent audits and reviews of the audits. Accounting audits examine all aspects of the transaction-processing system: from data collection, to data storage security, to accuracy of calculations and reports. Auditors also check physical assets (particularly bank accounts) to ensure that the numbers listed on the financial statements tie to real-world data. As shown in Figure 6.32, bank accounts are a critical element of auditing because they are maintained by external companies. Similarly, inventory and customer sales are at least sampled to ensure that they match against the internal financial records. These external numbers help anchor the internal statements. For example, it is hard to falsify the books if you have to match the cash balance at the bank. But not impossible. Somehow the Italian dairy company Parmalat managed to list $5 billion in cash in a Cayman Island account from 2002 to 2004 that did not exist.

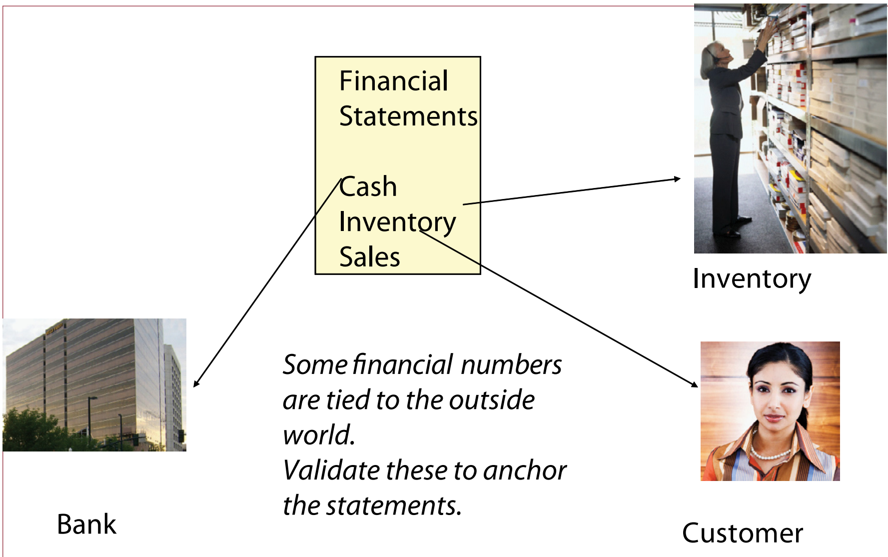


Figure 6.32

Financial audits. Verifying the quality of the data requires tying elements of the financial statements to externally validated numbers. Inventory can be physically counted. Customer sales can be sampled, and bank data must match the internal records.

Auditors also focus on the transaction and reporting processes. Do standard procedures encourage the timely and accurate recording of all data? Do people follow the standard procedure? The generally accepted accounting practices (GAAP) were created to establish standards and guidelines for accounting procedures. Today, one of the purposes of accounting software is to encode these practices into the system. In one sense, corporate accountants and managers are given less flexibility. Yet from management's perspective, the software encourages everyone in the firm to follow the proper procedures. Of course, some companies and managers will find these procedures too restrictive. Particularly if the company uses highly individualized practices and nonstandard production techniques.

One of the strengths of an ERP is the ability to define and enforce rules that apply to transactions. Accountants and auditors build the rules to maintain data integrity—often through separation of jobs. For instance, you can require a sales manager to verify all sales data entered by salespeople. Expenses can be automatically submitted to review by managers, and rules can be added to identify and flag unusual activity or high values. Receipt of supplies can be automatically checked against purchases Vendor identification and payments can be handled relatively automatically. Today's auditors spend considerable time evaluating ERP rules and procedures to ensure standard practices are followed to protect the integrity of the financial data.

Cloud Computing

Why do most companies avoid cloud computing for ERP systems? It is tempting to think that cloud computing would be a natural fit for ERP systems. The software is complex, and cloud systems could automatically maintain critical backup facilities for data and servers. Companies could access their data using simple computers with Web browsers from anywhere in the world. Because all companies need basic accounting and HRM software, it should be possible for vendors to provide online systems. And, several companies do provide these cloud-based services. NetSuite is one of the leading independent providers. The main vendors, including Oracle, SAP, and Lawson also provide options for hosting their software online. The primary benefit to online hosting is that companies need fewer initial resources and staff to maintain the hardware and software. Most of the costs become variable costs—largely based on the number of users.

However, many companies have avoided using cloud computing for their primary accounting ERP systems. Some of the reasons include concerns about security, privacy, and reliability. Cost, and the perception of cost, is also an important issue. Most ERP systems require customization—regardless of whether the system is online or run internally. These costs can be a significant portion of ERP design and implementation. Managers are also leery of variable costs based on the number of users. Most managers expect (wish) their company to grow—so they anticipate increases in the number of future users. With in-house, fixed systems, this growth generally does not cost extra money for the ERP (until hardware has to be scaled up with large increases). With cloud-based systems, managers anticipate increased costs every year, so they perceive costs as lower with their own system.

Large companies generally built their own systems and hired personnel to maintain them before the cloud-based systems became available. It would be difficult for them to justify switching—particularly if switching requires recreating the customized components. Consequently, most cloud systems target small and mid-size businesses. Yet, small businesses are likely to have minimal accounting systems and rely on simple systems and probably a single accountant. They are unlikely to see much benefit from an online system that requires continual monthly payments.

Another factor in holding back online systems is that browser-based ERPs are relatively new. Plus, mobile Internet connections—particularly in the U.S.—have been relatively slow and expensive. As ERP software, networks, and mobile technologies improve, more businesses might see a value in using online systems.

One area that has attracted companies is CRM. Salesforce.com has been relatively popular and experienced high growth rates. However, many companies treat their Salesforce data independently from their ERP data. It is largely used as a contact-management system. Salespeople use the system to share contacts and notes with others in their company. But, this data is probably not connected to in-house data including production and shipping—unless people manually transfer the information. Still, these cloud-based CRM systems appear to provide benefits to companies and salespeople so they continue to use them until more integrated tools become available.

Summary

Every organization must perform certain basic operations: pay employees, manufacture products or services, pay bills, monitor revenue, and file government reports. Operations are relatively structured, short term, and easy to computerize. They form the foundation of the company. MIS supports operations by collecting data and helping to control the underlying processes. Transaction-processing systems are responsible for capturing, storing, and providing access to the basic data of the organization. The goal is to capture the transaction data as soon as possible.

Common collection methods include point-of-sale devices, process control, electronic data interchange, and electronic commerce Web sites. Because data is the foundation for all other decisions, transaction-processing systems must maintain data integrity and minimize the threats to the data.

Even when the firm has production and sales in multiple nations, ERP software makes it possible for managers and executives to get a complete up-to-date picture of the entire company. Equally important, this level of integration makes it possible to change the way the company operates. Instead of relying on mass production to lower costs, companies can focus on the customer and the market. Working from the customer perspective, the firm can produce the items and options desired by the market. This type of production is possible because the information is instantly available to production and to suppliers. Integrated data on customers improves relationships with customers by enabling companies to identify client needs and respond to problems faster.

Integrating accounting, production, sales, and employee data makes it easier to identify bottlenecks, identify and reward the best employees, and gain a competitive advantage. Ultimately, the key to ERP systems is not the software—it is the integration and reengineering of the business operations that make your company better. The tools provide the ability to change the way the firm operates, and to use these capabilities to find a better overall solution. Whether the firm manufactures products or is a service firm or governmental agency, you can find new ways to operate when everything is integrated.

A Manager's View

How do you keep up with the thousands or millions of transactions in a modern organization? Information systems have been developed to handle internal data from accounting, human resource management, and production. Enterprise systems integrate the many pieces into data that is consistent and accessible across the organization. Increasingly, it is possible to interact electronically with other companies. These systems make it easier to identify and interact with your customers and suppliers. The integration makes it possible to alter the way the company is structured and managed. Creating agile firms that use mass customization to deliver exactly what the customer wants at costs comparable to those experienced with mass production.

Key Words

- accounting journal
- audit trail
- bill of materials
- chart of accounts
- continuous quality improvement
- customer relationship management (CRM)
- digital dashboard
- distribution center (DC)
- drill down
- electronic data interchange (EDI)
- enterprise resource planning (ERP)
- exception reports
- executive information system (EIS)
- extensible markup language (XML)
- extensible business reporting language (XBRL)
- general ledger
- just-in-time (JIT)
- magnetic ink character recognition (MICR)
- mass customization
- optical character recognition (OCR)
- point of sale (POS)
- process control
- radio frequency identification (RFID)
- request for proposal (RFP)
- supply chain management (SCM)
- transaction processing

Web Site References

	General Travel Reservations
Expedia	www.expedia.com
Kayak	www.kayak.com
Orbitz	www.orbitz.com
Sabre Travelocity	www.travelocity.com
	Discounts
Bestfares	www.bestfares.com
Cheap Tickets	www.cheaptickets.com
Priceline	www.priceline.com
TravelHUB	www.travelhub.com
	Individual Airlines (U.S.)
Alaska/Horizon	www.alaskaair.com
American	www.aa.com
Delta	www.delta.com
Frontier	www.frontierairlines.com
Jet Blue	www.jetblue.com
Southwest	www.southwest.com
United	www.ual.com
US Airways	www.usairways.com

Review Questions

1. Describe four methods of data capture.
2. What is the role of XML in EDI transactions?
3. What is the purpose of XBRL?
4. Explain how to a vendor all payment methods have costs.
5. Why are customers unlikely to adopt a new payment mechanism?
6. How do accounting and financial systems form the backbone of ERP systems?
7. Why are human resource management systems such an important component of ERP systems?
8. How are distribution centers used to reduce inventory, and what information is needed for them to operate efficiently?
9. What is the role of a DBMS in an enterprise resource planning system?
10. What are the primary features and capabilities of an enterprise resource planning system?
11. How does supply chain management enable a firm to change its structure and focus?
12. Why is customer relationship management so important? Why does it require an integrated system?
13. Why is an executive information system or digital dashboard so important to an ERP system?
14. If you start a new company, would you use cloud computing to handle your accounting system? Why or why not?

Exercises

1. Choose 10 Web sites that sell items or content. Create a table and identify the payment methods that they support.
2. In 2010 and 2011, a few cell phone companies tried to create a new standard to enable people to pay for items with their cell phones. Why did that project fall apart? What alternative, but similar method is being pushed?
3. Identify the primary government laws and rules that are designed to protect the government's interest in transactions.
4. Assume that you are running a small manufacturing business. To reduce costs, you want to contract with an overseas manufacturer to build a key component. How would you locate a company do to the work? What transaction details and data sharing will you have to set up to make the process work?
5. Find a balance sheet and income statement for a company (Try the EDGAR system at www.sec.gov). Rebuild the two statements as separate pages in a spreadsheet.

C06E06Base.mdb

6. Create the basic forms needed to use the database in a transaction system.
7. Create the spreadsheet in Figure 6.19 that shows the initial integration. The database file contains the basic data. You should build queries and import the data into a spreadsheet to create the analysis and charts. It is best if you use dynamic links.
8. If you have access to an ERP system, take a specific role (salesperson, production manager, customer, supplier, etc.) and use the system to enter data and check on the current status variables for your role.
9. Choose an industry (for example, automobiles, bicycles, or spare parts). Research the industry and identify what aspects follow mass production versus what operations follow mass customization strategies. Identify whether the industry sells predominantly to consumers or other businesses.
10. Find two cloud-based accounting systems that could be used by a business with revenues of about $1 million a year and 50 employees. If possible, estimate the costs of the systems. Pick one and explain why it is better than the other.

Technology Toolbox

11. Find information on at least two accounting or ERP packages that could be used for a business with 100 to 150 employees. Identify the strengths and weaknesses of each package. Are the packages tailored to specific industries?
12. You need to select an accounting or ERP package for a small service business, such as a law firm or accounting firm. Identify the major features that you want to see in the accounting system.
13. You have been hired as a consultant to a small graphics design firm with 20 employees. Design a digital dashboard for the owner-manager to monitor the important variables of the company.
14. Compare the purchasing capabilities offered by two ERP vendors. Visit their Web sites and view the demos. If possible, include copies of the main purchasing forms from each vendor. Summarize the similarities and differences.
15. Find an organization that uses a digital dashboard-executive information system. Identify the major components on the main screen, and briefly explain how the system is used to drill down to additional information.

Teamwork

16. As a team, find at least 10 Web sites that deal with international customers and point out the features that they provide that might not exist or are different on typical American Web sites.
17. Assume you want to create a customer relationship management system for a company that sells supplies and products to hair salons. Each team member

should find one CRM product then identify the strengths and weaknesses for this task. Combine the results and select one tool to recommend to management.

18. Each team member should research one ERP system. Identify the internationalization features available. Assume you are running a midsize company with offices and operations in several European nations. Describe the benefits provided by these international features. Make a recommendation on which product to buy.
19. As a team, research the status of XBRL in financial reporting. Identify which organizations require its use, which tools can generate XBRL reports, which tools exist to retrieve and analyze XBRL data, and so on.
20. You have been hired as a consultant to a midsize agricultural company that packs fruit and ships it to retail outlets. The fruit is grown under contract at regional farms. About 65 percent is sold to grocery and chains and fruit stores in the United States, while the rest is shipped overseas to high-end stores and restaurants. Design an ERP system with a digital dashboard for this company. Assign individual components to each team member. Be sure to identify potential problems and risks that might arise.

Rolling Thunder Database

21. Identify the major transaction-processing components in the system.
22. What features are used in the database and the forms to ensure quality of transaction data?
23. For each major transaction type, identify the sequence of steps that are performed and determine which ones are time critical.
24. For each major transaction type, estimate the frequency of the transaction and the volume of data involved.
25. Using the existing forms, perform the following tasks for Rolling Thunder:
    a. Take a bicycle order.
    b. Assemble a bicycle.
    c. Create a new purchase order.
    d. Record the receipt of purchases.
26. Extract sales and cost data by model type and create a spreadsheet to analyze it. (Hint: Use the Extract Data form.) Write a short report discussing profitability and any trends. Include graphs to illustrate your comments. Your spreadsheet should look at monthly sales by model and monthly material costs by model. Be sure to compute profit margins and examine percentages.
27. Assume that Rolling Thunder is experiencing problems with quality control. Suddenly there are several complaints about the components. Write a report describing all of the data and reports we would need to help us resolve these problems.

28. Top management needs an analysis of purchases and deliveries from vendors. Begin by using queries to extract the appropriate data to create a basic spreadsheet. Write a report analyzing the data; include graphs to illustrate your points.

Vendor	Purchases Order total $	Percent of vendor total	Received $	Receipts % of purchase	Avg. # days to deliver

29. Describe how an ERP solution could improve operations at Rolling Thunder. What operations would you implement first?
30. Describe how Rolling Thunder Bicycles might use a supply chain management system. In particular, how would it integrate with its suppliers?
31. Describe or create a subsystem that could be used by the head of sales management to monitor and improve customer relationships and sales.

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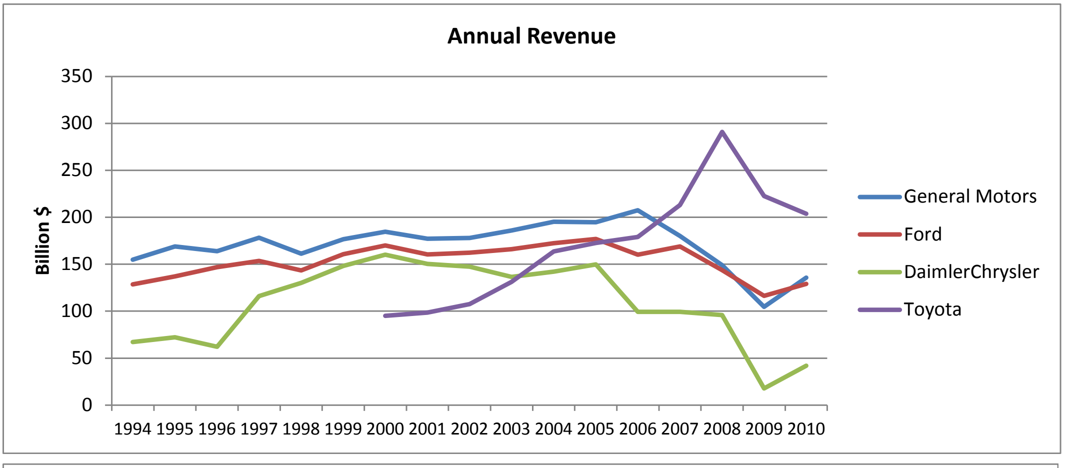
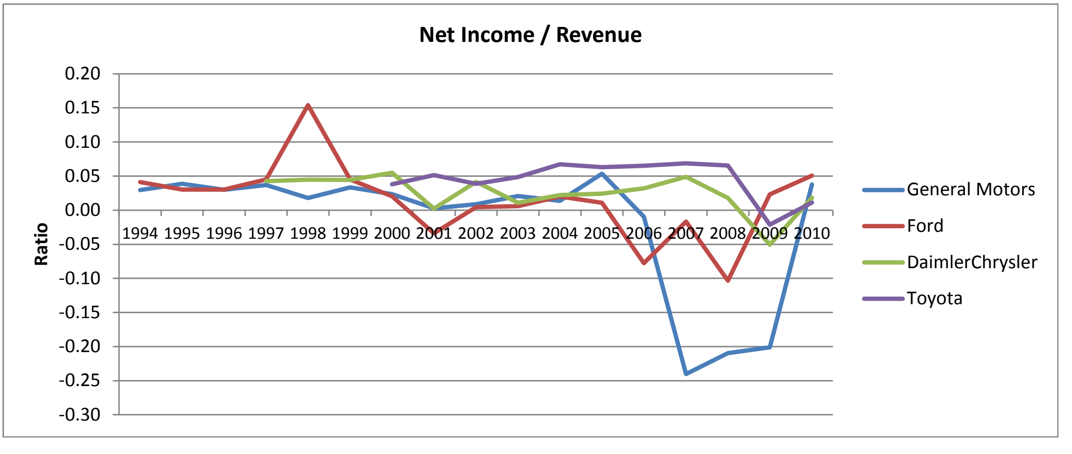
Cases: Automobile Industry

The Industry





Automobiles remain one of the most expensive, complex products sold to consumers. Manufacturing requires thousands of steps with parts acquired from hundreds of suppliers. And people buy cars for more than transportation—they are purchased based on image and style. As Ralph Szygenda, legendary CIO of GM puts it: "GM is ultimately in the fashion business, and to win, the company needs the best cars and trucks, which we have, with more to come" (Szygenda 2003). Perhaps he was a bit optimistic. North American sales for 2003 dropped to 16.6 million vehicles. GM had the largest market share at 28.3 percent, followed by

Ford (20.7), DaimlerChrysler (12.8), Toyota (11.1), and Honda (8.1) (Warner 2004). The astonishing number is found in the 1960s when GM's market share was over 50 percent. However, the declining share is not all that it seems. Check the Web sites of the big three companies and you will quickly see that they have bought up several other brands over the past years. Dig a little deeper into GM's annual report and you will find that the company at one time owned shares in Subaru, Suzuki, Fiat, and Daewoo, among others. Ford has similar arrangements with other companies. By 2010, the total U.S. market share for the big three manufacturers (GM, Ford, Chrysler) was only 45 percent.

Company	2010 YTD/May		Company	2010 YTD/May
GM	19.1		Hyundai	4.4
Ford	16.9		Mazda	2.1
Chrysler	9.4		Subaru	2.3
Toyota	15.2		Mercedes-Benz	1.9
Honda	10.5		BMW	1.8
Nissan	8.1			

Market Share: http://online.wsj.com/mdc/public/page/2_3022-autosales.html#autosalesE

Most of the firms in the industry also faced a huge problem they referred to as legacy costs. Over the years, the heavily unionized American firms promised huge pensions and health care benefits to their employees. Now, they face billions of dollars in fixed cost payments to retirees—costs that were never fully funded from prior operations. So, a substantial percentage of current sales revenue went to paying these costs.

Competition

In general, the industry is highly competitive. It has been estimated that the Detroit big three have an excess production capacity of 2.5 million vehicles (Plunkett Research). Total U.S. sales fell slightly in 2003 to 16.6 million new vehicles. Compounding the problem is the fact that many of the sales have been driven by deep discounts—either in price or in financing deals. At one point, in 1993, Ford pushed so hard to make the Taurus the number one selling car, that it was giving discounts of $2,600—a considerable sum at the time. Most observers believe Ford was losing money on every car (White 2004).

At the same time that the American car companies appear to be suffering, it should be noted that only 40 percent of Americans can actually afford to buy new cars (National Independent Dealers Association). In 2001, the Bureau of Transportation Statistics reported sales of 8.6 million new passenger cars (not trucks) and 40.7 million used passenger cars (and 11 million new bicycles) (www.bts.gov). Used truck numbers are not reported, but in terms of new vehicles, cars make up about 50 percent of the total number of vehicles. In any case, sales of new vehicles account for about 17 percent of automobile sales. Globally, about 60 million vehicles were sold in 2003 (GM annual report).

Sales of American vehicles have continued their decline. In 2007 Ford experienced an 8.1 percent drop in sales, Chrysler Group sales fell 1.4 percent, and GM sales dropped by 21 percent. In contrast, most import manufacturers reported double-digit increases in sales (Lam 2007). Ford and GM both reported that part of the decline was due to a reduction in sales to car rental fleets. The manufacturers are trying to move away from these low-margin sales. Sales were also down for most other months in early 2007. The domestic manufacturers announced sales promotions for July. Also in 2007, Daimler, the German parent company announced the sale of Chrysler to a private equity firm. The U.S. auto industry also faced huge pension-fund and health care costs that were promised to workers and retirees decades ago.

Technology and Management

The ultimate question the automobile industry faces is: How do you manage such a large, complex company? In 2003, GM had 326,000 employees worldwide, and revenues of $185 billion (annual report). The company ran 32 plants in North America alone (Garsten 2003). By 2010, the number of employees was down to 202,000 (2010 annual report). With multiple divisions, thousands of designers and engineers, and a recalcitrant union, how can anyone possibly determine what is going on, much less control it? As one of the largest companies in America for over 60 years, GM is an interesting case in management and mismanagement. The company was initially created by combining several independent brands. Alfred P. Sloan, who organized and ran the company in the 1930s, knew that with the information system available at the time, he could never control an organization that big. His decision was to let the divisions run somewhat independently, but report to a set of policy committees and central staffs in a system he called "decentralized operations and responsibilities with coordinated control" (Taylor 2004). All auto manufacturers have struggled in the last couple of decades with the question of how to control the huge organizations. As technology has improved, new options have been created that provide for increased central control across the entire organization. Tools such as global networks, CAD-CAM systems for engineers, workgroup and collaboration systems for managers, and enterprise resource planning systems for operations and finance make it possible to share data. Yet installing these systems is only the first step. It is also necessary to change the way the company runs. And that can be difficult in an organization used to flexibility and defined ways of functioning that evolved over decades.

The automobile manufacturers have tested many variations of information technology over the past decade. The industry spent billions of dollars on telematics (integrating information systems into the vehicle). It has spent billions more on supply chain management and enterprise resource planning systems. Today, most of the $3 billion a year that GM and Ford spend on IT goes to operations—keeping the existing systems running (Piszczalski 2002). The companies have still not achieved total integration of their systems, and might never reach that state. But they are still interested in tools that can solve specific problems and provide gains in quality, cost reduction, and bringing new models to market faster.

In 2007, Ford announced a partnership with Microsoft to install an integrated in-car communication and entertainment system. The system has USB and Bluetooth ports for establishing connections to most consumer electronic devices. It also supports voice-activated calling—increasingly important as more states ban hands-on cell phone use in cars (Rosencrance 2007).

The Crash of 2008

The recession of 2008 was the last straw for GM, and the company filed for bankruptcy on June 1, 2009. In the process, the U.S. and Canadian governments bailed out GM (and Chrysler) with billion-dollar infusions of cash. In exchange, the two governments gained partial ownership rights to the two companies. Ford had fortuitously refinanced several loans right before the crash and was able to avoid the financial crunch and did not file bankruptcy or require government subsidies. In the cleanup process, GM shed most of its "legacy costs," by creating a new company that holds mostly newer assets and dropped the pension fund obligations. In exchange, the unions gained control over most of the new GM shares. In November and December 2010, the new GM issued an IPO and became the new GM (2010 Annual Report). Chrysler was sold to Fiat, the Italian car company. Ford remains as an independent company. Both GM and Ford sold off or closed several car divisions. For example, GM closed Hummer, Pontiac, and Saturn, and discarded Saab; leaving the company with Chevrolet, Buick, Cadillac, and GMC in the United States. Ford sold Jaguar and Land Rover to Tata Motors and closed the Mercury division.

The other big changes in the industry stem from the rising price of gasoline in 2010—hitting over $4 per gallon in most states in 2010 and 2011. This price level encouraged people to search for cars with better gas mileage—particularly hybrid gas/electric cars. Although the American companies had some hybrid cars available, the Toyota Prius was the industry leader by a long shot. In 2011, GM began selling a hybrid car that could run 40 miles on electric power, and Nissan introduced the Leaf—an all-electric car. Huge uncertainty remained over whether customers would buy all-electric cars and whether it would be possible for the cars to have a long enough range to be useful as a primary vehicle.

The third overall trend is that total sales outside the U.S. exceed the value of sales within the U.S. By 2011, China had become the largest automobile market in terms of the number of vehicles sold. For example, GM sold 8.4 million vehicles worldwide in 2010 and 2.2 million in the U.S. The total industry sales in the U.S. were 11.8 million, and total worldwide sales were 73.6 million (GM 2010 Annual Report). Worldwide, Toyota was the largest automobile manufacturer in 2010.

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Case: Ford

Ford (ticker: F) has presented several interesting cases in management over the years. Driven initially by Henry Ford's efficient adoption of mass production, the company dominated the automobile industry. Through all of the changes in the industry, technology, and finance, the company has largely remained under the control of the Ford family (40 percent of the voting stock). In October 2001, the family ousted Jacques Nasser and Henry's great-grandson, Bill Ford became CEO. The firm struggled for a year, trying to recover from its earlier problems. One of the major changes implemented by Mr. Ford was an emphasis on profits—instead of raw sales numbers. Toyota is close to overtaking Ford and becoming the number two car company in the United States. Mr. Ford's comment: "I don't want to be the biggest. I want to be the best." With lower sales, Ford surpassed GM in profits for 2003 (White and Shiorouzo 2004).

Revenue Decisions

The automobile industry is a classic case of mass production. Building thousands of identical cars and trucks reduces costs. But then you have to sell them. Does everyone want the exact same car or truck? In 2001 and 2002, Ford began to re-evaluate its strategy, with a focus on identifying the source of profits. Why build 300,000 Tauruses if the company loses money on each car? In the process, the company found that it needed to track exactly which vehicles are selling, what features are in demand, and the details of regional preferences. Bill Ford promoted Lloyd Hansen to a corporate vice presidency in charge of overseeing revenue management—identifying exactly which products should be built. The company began analyzing data from existing sales channels. More important, it combined consumer Internet research data to identify regional choices. Mr. Hansen says that the company was surprised to find consumers in sunny states were interested in four-wheel drive pickups. "There was always this gut-feel paradigm that people who live in Texas, Florida, and California don't need a 4-by-4" (White and Shiorouzo 2004). By sharing the data with dealers, Ford increased shipments of the more expensive trucks. Ford uses the same information analysis to target discounts more precisely. With truck sales, Ford was able to increase revenue by $934 per vehicle from 2003 to 2004 (Taylor June 2004).

Think about the decisions required for revenue management. The key is that you have to decide exactly which products to produce tomorrow. You have dozens of cars and trucks, each with several trim variations. You have dozens of plants. You have some data on sales and profits. Should you produce 1,000 Ford Explorers that might generate $4,000 per vehicle in profits, or should you run 1,000 Focuses with lower profit margins. If you do run the Explorers, how much discounts should you give to get them sold? Keep in mind that this is a $25 million decision that you have to make every day (White 2002).

Now, make the process even more complicated: what are your rivals going to do? If Cadillac offers a rebate on the Escalade, how will that affect sales of the Navigator? Should you match the discount, or accept the possibility of lower sales at higher profit margins? What is the probability that Cadillac will offer that rebate? More importantly, if you respond, will they retaliate and offer even larger discounts? Few models are actually this sophisticated today, but in reality, you need to forecast a huge number of variables to make these decisions.

Production Management

The system of mass production makes it difficult to respond to changes in demand. Forecasts are helpful, but Ford has worked hard to add flexibility into its production system. In particular, it is working to build different versions of cars from the same plant. At one time, each plant was designed to produce only one type of car. Today, plants need to be able to switch production so that when demand for crossover wagons increases, the company can stop producing sedans and build the high-demand cars instead. Toyota and Honda pioneered these practices, and Ford is still trying to catch up, but the company is making progress. Many of these changes are being implemented in the new Chinese plants. The goal is to put in only enough capacity to meet current demand, but enable the plants to expand quickly if demand takes off (White and Shirouzo 2004).

Of course, it always pays to improve efficiency in production. Ford's plant in Cuautitlan, Mexico, produces 300,000 to 400,000 cars and trucks a year. It uses a just-in-time production system, where suppliers deliver parts as they are needed on the line—instead of holding them in inventory. Until 2002, the partially completed vehicles were tracked through manufacturing and painting using paper identification sheets. But this manual system generated huge numbers of errors from lost, damaged, or switched sheets. Ford called on Escort Memory Systems from California and CAPTA from Mexico to convert the system using radio frequency identification (RFID) tags. Dealing with the electronically dirty manufacturing floor and the 220° C paint oven temperatures was a problem. The companies used high-temperature RFID tags with 48-byte memory and 1,200 bytes/second transfer rate. The tags were attached to the pallets that carry the vehicle bodies through the plant. Antennae were embedded in explosion-proof containers in the floor under the conveyor belts. As each skid passes over an antenna, the system reads it and feeds the information to the central control system (Johnson 2002). In 2004, ford installed WhereNet Corp.'s real-time parts-locating system in its F-150 truck plant. The system changes production from a push-based inventory supply to one that pulls products onto the line when an operator pushes a button. The system knows which parts are needed and delivers them to the job site just as they are needed (Rosencrance 2004).

In a fashion market, producing new models quickly is critical. Ford has reduced its development time by 25 percent from the late 1990s and is getting better by 10 percent a year. Still slower than Toyota, but Ford was able to produce a third of its new models in 30 months or less (Taylor February 2004).

Turnaround

Ford weathered the recession and liquidity crisis that took down GM and Chrysler, but it faced many of the same pressures in terms of lost sales and restructuring.

CIO Nick Smither arrived at Ford before the 2008 crisis, but Ford had already slashed costs and dropped models. Smither noted that "I have always said a career in IT is a career in change management. But no one could have anticipated this level of change" (Johnson 2010).

One of the changes at Ford was to simplify production and ordering—by reducing the number of configurations. For example, up to 2008, a customer could order a full-size SUV with one of 76,000 configurations. By 2010, the list was cut to 1,500. Not exactly simple, but easier to produce. Ford also reduced the number of vehicle platforms, from 27 down to 15; and it wants to use those for all global production. IT costs have also been slashed, and Smither focused on removing excess capacity and duplication. It dropped from six data centers down to four and cut the application portfolio by 40 percent. The company added new collaboration tools and built standardized systems to support integrated design, procurement, sales, marketing, and manufacturing processes. It also developed new in-vehicle communication and entertainment systems. All while cutting IT staffing by 20 percent (Overby 2010). The CIO now reports to the CEO and meets weekly with corporate executives to restructure the entire company into a single system. For example, a new WebQuote system is used by all engineers in Ford to define products and solicit quotes—from any division around the world. Everyone sees the same data and same suppliers.

In cooperation with Microsoft, IT also developed the in-vehicle Sync system that integrates and controls everything from the radio, to seats, to the navigation system. It is largely voice-controlled and is highly praised by most customers.

Questions

1. How does Ford's information system help them reduce costs and add flexibility to the production line?
2. What data is provided by the ERP system that can be used to make tactical and strategic decisions?
3. What type of data does Ford need to know to build its forecasts and plan production levels? How does the ERP system provide this data?

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Case: General Motors

General Motors (ticker: GM) began life as a diverse company—a collection of manufacturers loosely controlled through a central organization. It really has not changed much over the years, but it keeps trying. Even the bankruptcy filing and "new" GM did not actually change the management structure—although it did bring in a couple of "outsiders" as CEOs.

Product Management and Marketing

The "old" GM listed nine major brands on its home page (without Buick). And that list does not include several European and Asian brands that are fully or partly owned by GM, such as Opel, Vauxhall, Daewoo, Fiat, Isuzu, and Suzuki (Plunkett Research 2004). Imagine trying to monitor the dozens of companies, product lines, and markets. One step GM is taking is an attempt to build a central European database encompassing clean data from Spain, the Netherlands, and the UK. Most of the work is being done for its Daewoo division. The goal is to create a consistent list of its 700,000 customers and prospects and make it available from its Amsterdam headquarters. Daewoo's UK direct marketing and e-commerce manager, Matthew Young, notes: "In Europe, it was apparent that we had no continuity or integration of style. This will also plug the hole in our cost efficiency" (GM Daewoo 2004). The "new" GM was down to four domestic brands, plus ownership in several international companies (2010 Annual Report).

Production and Collaboration

Production of automobiles is changing—particularly as the automotive technology changes. For example, the gas pedal in the 2004 Corvette is not mechanically connected to the engine. Instead, it is an electronic connection—much like the fly-by-wire Boeing 777 jet. Many cars have 30 wireless sensors in them, with plans for new models with over 50 devices in them. Tony Scott, chief technology officer at GM, notes that "we spend more per vehicle on software than we do on steel," and that software has to survive the 10-or-more-year life of the car (Sullivan 2003).

Implementing new technologies into automobiles is a complex task. Advances have to be evaluated, tested, and priced to match the level of the automobile. To handle the changing technologies and track which ones are being used in each vehicle, GM adapted a technology road mapping process developed at Saab (at one time a subsidiary of GM). The basic process places the model year on the X-axis of a chart, and the Y-axis represents increasing performance. Individual projects are drawn on the chart to show if they are funded or unfunded, and when they started. Collecting the data for charts across the organization was not easy. Eventually, a database-driven Web site was created to hold the information about existing and planned projects, containing the description, budget, development stage, key personnel, cost, and planned applications. Even then, most divisions were reluctant to enter the appropriate data. So, GM forced divisions to enter data by explaining that if there was no data in the database, then the project must not be important, and it would not be funded. The process was useful for some groups, but avoided by others. The good news is that everyone could see how the various projects scattered across the company were related. For example, electronic steering was going to rely on the 42-volt electrical system (older cars use a 12-volt system), so the timing of the two projects had to match. The system also showed several redundant projects, which caused conflicts because everyone wanted the "other" project to be canceled (Grossman 2004). A powerful extension of the road mapping process was to extend it to suppliers. For example, by overlaying Motorola's road map, engineers could plan for future capabilities.

Automobile manufacturers are really assemblers and integrators. Each plant has thousands of suppliers who provide everything from individual bolts and glue to fully assembled cockpits and seats. Each of these companies has additional suppliers. How can anyone track the orders and solve problems if something goes wrong several layers deep into the supply chain? Product life cycle management (PLM) software presents one answer that is being used in the automotive world. The system enables GM to track the source of all components used in a product during its lifetime. It also provides information to the supply chain participants. Terry S. Kline, GM's global product development process information officer, notes that "in product development, IT projects like PLM have helped pare a billion dollars of cost over the past three years." But Kline also quickly notes that the system has also helped reduce the time-to-market from idea to product from 48 months to 18 months (Teresko 2004). About 80 percent of a car and as much as 70 percent of the design content comes from outside the automobile company. PLM integrates the business information with the engineering (computer integrated manufacturing) data and shares it with other members of the supply chain.

Making the thousands of decisions and setting strategy is incredibly difficult. Rick Wagoner, the CEO, noted in 2004 that "we didn't do everything right over the last 12 years. About three times during that period you think you've got it, and then something else comes up. We made huge progress in '92, '93, '94, but then we started to pay the price because we had, out of necessity, underspent (on new products) during that tight period and didn't do that well on the revenue side. Then, in the last three or four years, we've run the business very well, but the pricing has been tough. So my lesson—these aren't complaints but an observation—is, Don't ever think you've got it licked, because you probably don't. This is not a one-step game. This is a multiple[-year] thing, and it's hard, and you learn as you go along. The key thing is to remember what you've learned so you don't have to relearn it" (Taylor 2004).

In early 2007, GM signed a $1 billion five-year contract with AT&T to provide global IP services supporting voice, data, and video communications around the world. The system provides a global virtual private network for GM based on Multiprotocol Label Switching (MPLS) that supports routing packets by priority values. Ralph Syzgenda, CIO at GM, stated that "The real end goal is that every employee has the same type of capabilities no matter where they are in the world, and in fact, when they wake up, they don't need to know where they are in the world. It just works." (Thibodeau 2007).

Technology in cars is also increasing. In 1990, a typical car ran software consisting of one million lines of code. By 2010, the number is expected to increase to 100 million lines. Software and electronics in 2004 constituted one-third the cost of the car. GM is concerned about managing the software development process and the liability. Anthony Scott, chief technology officer for GM's Information Systems and Services organization said that "People love to sue GM when they get into an accident or have some sort of a problem. As more and more software comes into the car GM is going to expect [software developers] to participate at some level in that liability." (McMillan 2004).

Information Technology

Ralph Szygenda is already a legend at GM. As its first CIO in 1996, he inherited several problems. GM had tried to simplify its IT functions by outsourcing computer management to EDS—of course, the company wanted to keep the profits, so it purchased EDS. But the IT departments were still not running smoothly. Among other problems, it took the company 48 months to develop a new car. Szygenda went several steps further into outsourcing—by moving to a multivendor approach, forcing them to compete against each other, yet still cooperate to provide products that worked together. In the process, he slashed annual IT spending from $4 billion to $3 billion, and installed 3-D virtual reality modeling software along with a collaborative infrastructure. Model development time dropped to 24 months. The time it takes to deliver a special-ordered vehicle dropped from 70 to 30 days. To control the outsourced components, Szygenda kept 2,000 IT managers in house. He observes that "when I first started doing this, people said you couldn't outsource critical aspects of the company, and I agree with that. Those 2,000 [managers] are the critical part, but the hands, arms, and legs of building IT can be outsourced" (Zarley 2003). Szygenda uses the 800-pound gorilla clout of GM to keep suppliers in line and encourage them to adopt standard procedures.

A frustrating problem for customers arises when they take a vehicle to the dealer for a repair, but the dealer does not have the repair parts in stock. Dealers do not like to carry large inventories because the carrying costs are too high. GM maintains an inventory of 1.3 million parts and dealers typically stock from 5,000-12,000 parts. In the past, GM relied on the judgment of individual dealer parts managers, who waited until the end of the week to submit a batch parts order. The practice also caused problems for GM distribution centers as workers rushed to fill orders from hundreds of dealers arriving at the same time. To reduce the problems, GM installed a Retail Inventory Management (RIM) system that tracks daily parts usage at each dealer. The data is sent to the regional distribution center and replacement parts are shipped to the dealer. A pilot test involving 350 dealers in Florida resulted in a smoother work load with an order variance of 2 percent compared to 21 percent before installing the system. The system also uses analytics to recommend which parts to stock at each dealership. GM's Saturn division had used a similar system for years, but it was a challenge to build the new system to integrate thousands of dealers using diverse systems (Thibodeau 2006)

Technology has not always been successful at GM. In the 1990s, it installed a computerized system for dealers that required them to order cars 90 days in advance, and it made it difficult to change orders. In the meantime, GM announced that it wanted to take over 700 dealerships and run them centrally. Then, the ordering system crashed and sales plummeted for a month. The system was eventually fixed, but the two decisions alienated dealers. Jack Smith, ex-CEO of GM, notes that these and other problems were exacerbated by market manager Ron Zarrella, who was brought in as an outsider from Bausch & Lomb. Smith notes that the car business is unique, and an outsider might say, "'That's really a dumb way to run." But the unfortunate thing is, that is the way it runs. There are some things you just have to live with (Taylor 2004).

GM, and other companies have begun experimenting with RFID tags to track parts through the supply chain and factory. For example, GM uses active RFID tags to store job information to indicate which parts need to be installed in each vehicle. But the company is still focused on using bar codes to track parts. Bar codes are substantially cheaper and are not subject to electrical interference from metals and chemicals on the production floor. Engineers do believe passive tags could be useful within the car, making it easy for repair people to quickly scan for the exact part installed deep in a vehicle (Weier 2006).

As one of the largest organizations in the world with plants and offices in 200 countries, 280,000 employees, thousands of dealers, and millions of customers, GM has an identity problem. GM has tried federating identity management systems from several companies, including tools from Novell, Siemens, Oracle, and Sun Microsystems. But James Heaton, global director of identity management said that "a lot of vendor solutions halfway work for GM, but when we try to scale them, they break. We break almost everything we touch the first time we try to use it." Even creating a system that handles password resets is challenging—particularly with multiple languages. If a user forgets a password, the system asks personal questions to identify the user and reset the password. When the system was installed, GM saw problems spike in Portugal and Brazil. One caller complained "I did everything the system told me to until I came to the validation questions about my goat. I don't have a goat." Obviously there was a translation error in the system, but it takes time and resources to spot the problems and fix them. The process is complicated because GM has 2,481 applications that require authentication (Babcock 2007).

In 2009, GM tried an experiment by auctioning a new car on eBay. The site allowed California buyers to place online bids for cars from 225 of the 250 dealers in California. A J.D. Power & Associates study had noted that 70 percent of buyers use the Internet for research before buying a car. The initial auction was successful, but most dealers already use the Internet and even eBay for sales—particularly for used cars (Barris 2009).

Near the end of 2009, Terry Kline became the CIO of General Motors when Ralph Szygenda retired. One of Kline's first goals was to upgrade desktops to Windows 7 (from XP), to make the systems easier and cheaper to manage. He was also exploring options to use cloud computing to reduce management costs of running new servers. But, he expressed concerns about the pricing models (Thibodeau 2009).

IT played some interesting roles in the development of electric vehicles—such as the Chevy Volt for GM. Because EVs are such a big shift for consumers and manufacturers, new design issues arise that do not have years of data or prior solutions. GM's approach was to build multiple sensors into all of the early test vehicles. As employees drove the vehicles, the data was collected and reported to the designers. IT built new tools to retrieve and analyze the data. The designers used the data to evaluate tradeoffs and make decisions on the batteries, motors, and user interfaces (Brandon 2011). IT was also heavily involved in designing tools for monitoring battery and charging levels. Most EVs have the ability to report various status items to users through Web sites and smartphone applications.

Questions

1. How does GM's decentralized structure affect the implementation and use of ERP systems?
2. How does an integrated production and design system help GM design new cars?
3. Why is an integrated production system so important for building custom vehicles?

4. Will GM eventually be able to build a higher percentage of custom-ordered cars?

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Case: Chrysler-Fiat

In 1999, when former Chrysler CEO Bob Eaton introduced the redesigned Jeep Grand Cherokee, he held up a bag that he claimed contained all of the parts that were carried over from the earlier design. He seemed proud of this huge design change. But the costs had to be enormous. Toyota saves billions of dollars by reusing as many components as possible. Reuse also leads to more flexible production and design, enabling Toyota to produce new vehicles in a few months instead of years (Taylor 2004). In 2007, Daimler spun-off the Chrysler Group by selling it to a private equity firm Cerberus. Daimler owned Chrysler for slightly under 10 years, and finally had to abandon it to restore profitability. In March, 1998 Daimler paid $36 billion for Chrysler and technically sold it for $7.4 billion, but the Wall Street Journal calculated that it would actually cost Daimler $650 million in cash to dump Chrysler. In the 2008 recession and liquidity crisis, Chrysler survived only through funding by the federal government. Eventually, the bulk of the company was sold to Fiat. The goal was to use Chrysler automotive technology (largely engines) to build larger cars in Europe and use Fiat's knowledge and production to build smaller cars for sale in the United States.

Technology in Manufacturing

In 2004, DaimlerChrysler had 104 manufacturing plants in 37 countries. Communication among the 362,000 employees was challenging across those distances. The company used videoconferencing and held more than 100 meetings a day with the technology, saving it as much as $14 million a year in travel expenses. The engineering teams used Web portals to share work and check on business information (Niccolai 2004).

In 1998, after the merger of Daimler and Chrylser, Susan Unger was named CIO and head of global IT operations of the new company. In the middle of the dot-com hype, she noted that she "had a different message, which was that in the 'e-world,' you have to have business value. It was kind of funny at the time because I was a voice in the wilderness talking that way." Because of this focus, the company worked on B2B initiatives. Unger notes that many other companies have had to write off their Internet projects, but "we have had none because we were kind of religious about ROI (return on investment" (Gibson 2004).

One of the big tools that DaimlerChrysler implemented was DELMIA from Dassault Systemes AG. Unger points out that as the engineer designs a vehicle, they can use the tool to create "a virtual manufacturing environment—including your work cells, your line, your equipment—and simulate your workers installing a wiring harness or whatever else." The multiple divisions (Daimler, Chrysler, and Mitsubishi) all use an e-engineering portal to share CAD information.

DaimlerChrysler was also a big user of the Covisint automotive auction system. Sue Unger noted that in 2003, the company used the system for almost 200 separate bids, saving it between 15 and 20 percent compared to traditional prices. More important, the system simplified the purchase process, reducing the time from months to days (Gibson 2004).

Auto Sales and the Internet

In the middle of the dot-com boom, some people were forecasting that all car sales would be made online within 6 to 10 years. Today, most sales are still made in person—partly because people want to see, touch, and drive the cars. Yet Sue Unger reports that 90 percent of buyers use the Internet for research before shopping (Gibson 2004).

Although DaimlerChrysler used incentives to try and gain market share for its primary models, Mitsubishi Motors was being hammered in the market. Their sales approach in 2002 did not help—when the company targeted first-time young buyers with a zero-zero-zero campaign. Essentially, even poorly qualified buyers could get new cars with nothing down and no payments for one year. Unfortunately, most of the cars had to be repossessed at the end of the year. In 2004, Mitsubishi tried to recapture market share through marketing. This time with a new twist—a return to Internet advertising. In 2001, the company abandoned Web ads as nonproductive. In 2004, the company is spending $6 million on the Web alone. DaimlerChrysler increased its Web spending by 30 percent in 2003 (Mangalindan 2004). Although the Mitsubishi campaign represents only 5 percent of its total advertising, the company believes the Web ads are more effective than other approaches. The key: targeted ads and quick ties to dealers. Tom Buczkowski of Silver Creek, New York, is one who responded to the new approach. Researching SUVs at the Autobytel site, he was presented with an ad from Mitsubishi. By signing up for a test drive, he won a $15 gas card. At the Mitsubishi site, he built a customized Outlander. The details and the personal data he entered were sent to the nearest dealer in minutes. The next day, the dealer called him and suggested a test drive. Mr. Buczkowski was impressed with the response "If you get a response from somebody a day after the request, that's something you don't find too often anywhere else." He eventually bought a Mitsubishi.

Given the size of auto manufacturers and the number of dealers, providing communications with the dealers was a critical aspect to selling cars. DaimlerChrysler included 5,300 U.S. dealerships and another 1,500 worldwide. The manufacturer provided 240 applications to the dealers ranging from support and training to sales. Prior to 2003, most applications were standalone programs running with little or no control on dealer servers. Richard E. Earle, CIO at the Chrysler Group, led a group to replace all of the applications with Web applications running on a central server and accessible through Web browsers. With 300 to 500 internal developers working on the project, the DealerConnect system was built in a couple of years. Serving 300,000 users in 10 languages, it servers 8 million pages a day (Ulfelder 2005).

After the buyout by Fiat, Chrysler provided little financial and production information. The company focused on selling existing models until new, smaller cars could be designed by the Fiat team. In 2008, Chrysler IT did move more of its IT operations offshore to be handled by the Tata Consultancy Services (Thibodeau 2008).

In 2008, Chrysler tested an offer of a Wi-Fi hot spot as an option in its vehicles. The system would provide Wi-Fi connections within the car and use cellular phone service to connect to the Internet. At a base price of almost $500 plus $29 a month for service, it is not clear how many customers would purchase the option. Within a year, many smartphones began providing similar services—and they would not be tied to the car.

Questions

1. How do integrated design systems solve typical problems that arise?
2. Check out the Web sites by the automobile manufacturers. Why are they so bad? As a customer, what additional features would you want to see?

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Case: Toyota

Since the gas crises of the 1970s, Toyota has been gaining U.S. and world market share on American automobile manufacturers. Toyota had the lead in small-car design. Over time, the company leveraged this knowledge of consumer preferences to improve quality. The company was also the first to adopt lean manufacturing techniques to reduce costs and formal integrated quality control to take the lead in quality. Eventually, the company introduced the Lexus division to capture a large share of the high-end market. By 2007, the company was approaching the number-two position in sales. With common Japanese kerietsu ties to suppliers, Toyota pioneered just-in-time inventory deliveries. These inventory- and quality-control measures require considerable communication with suppliers. Toyota has adopted computer technology to facilitate communications. Toyota is trying to grow production capacity but with an emphasis on flexibility. Using its ties to suppliers and dealers, the company can increase or decrease production at any plant on short notice. It also tries to standardize vehicle platforms and keep the line flexible enough so that it can switch each line to a different product depending on the demand (2006 Annual Report and Duvall 2006). As with other manufacturers, Toyota uses advanced CAD systems to design new vehicles and parts. With this technology, Toyota has been able to reduce design time for a new vehicle from four years down to between one and two years. Toyota also centralizes all of its data. The CIO and executives have access to all global data when making decisions (Miller 2006). Toyota briefly took over the number two spot in U.S. sales, but its momentum was derailed when the tsunami hit Japan in 2011, causing disruptions in the supply chains for many components.

Technology in Sales

From 2000 on, the world auto industry had an excess production capacity, leading to intense competition; particularly in the United States. Online Web sites such as Edmunds and Vehix also made it easy for customers to search for cars and prices from multiple dealers. Profit margins at dealers fell for several years. To help maintain overall profits, dealers had to get bigger to increase volume and spread the overhead costs. Many also carry multiple brands of vehicles. Gulf States Toyota is a distributor for 145 Toyota dealers in five states. The company processes more than 190,000 vehicles a year at an 84-acre facility in Houston, TX. The company faced a problem in 2004 where they either needed to add more buildings or find a way to get vehicles through the facility more efficiently. WhereNet Corp provided an RFID-based vehicle tracking system. New vehicles delivered by rail car are tagged with an active RFID sensor and the VIN is entered into a database. The facility has 40 wireless LAN access points and 74 RFID readers. As vehicles enter and leave the facility, the data is picked up and entered into the database (Rosencrance 2005).

Toyota USA also needs to communicate with dealers and distributors. An early communication system developed in the early 1980s was based on IBM AS/400 technology. The system handled parts ordering and warranty claims, but all other communications needed to be handled by phone or fax. With 1,100 Toyota and Lexus dealers, Toyota needed a better way to communicate and improve dealer productivity. The Dealer Daily system was created to handle all common communications. It is a Web-based system running over a virtual private network (VPN) that links the dealers to Toyota headquarters. Dealers can order parts, file warranty claims, and manage financing and insurance for customers. Dealers pay for access to the system with a monthly fee based on the bandwidth they choose. Dealer Daily can also deliver critical news and information directly to any user at any dealership. Toyota is also working on a build-to-order system that will be integrated into Dealer Daily (Rosencrance 2002).

Led by the Prius, Toyota is one of the leaders in hybrid vehicles. In 2011, the company began expanding the role and variety of electric and hybrid vehicles—making Prius a separate division. Toyota also struck a deal with Salesforce.com to create a private social network for owners of its hybrid and electric vehicles. The Toyota Friend network will enable customers to share data with Toyota and other owners. It will provide notices for maintenance schedules and other issues. It will also allow customers to share driving and maintenance tips with each other—something that is commonly done now through a variety of public Web sites (Jennings 2011).

Toyota faced a couple of public image problems when it had to recall millions of vehicles in 2010. For many years, Toyota was perceived as a quality leader, and recalls and negative press affect that image. To take the next step at maintaining high quality, Toyota developed a business intelligence (BI) tool to monitor six years' worth of product quality data pulled from internal systems. The system consolidates and standardizes the data, enabling engineers to compare and filter data on configurations, customer call centers, warranty claims, and service centers. Tom Trisdale, manager of Toyota's Technical Information & Diagnostics Group noted that "The great thing is, everything is available from one source. We can have results very quickly" (Vijayan 2011). By using off-the-shelf software from Endeca, the IT department built the system within a few months. Similar to other BI projects, 45 percent of the time was spent on cleaning and standardizing the data to ensure consistency.

Questions

1. Why is information technology so important for lean just-in-time production?
2. Why does Toyota use online searches for vehicles in stock instead of building cars to order?
3. Given the sophistication of Toyota's systems, why have defect rates and design problems increased?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 7

Electronic Business

Chapter Outline

What You Will Learn in This Chapter

- How do you make money on the Internet?
- What types of products are sold online?
- How do Web-based services work and why do they change the world?
- How can customers pay for products and why do you need new payment mechanisms?
- How do firms get revenue from Web ads and how do customers find a site?
- How do you create an EC Web site?
- How do portable Internet connections (mobile phones) provide new ways to sell things?
- When do consumers and businesses pay sales taxes on the Internet?
- Does the Internet create a global marketplace?
- What are the costs for cloud computing?

Wal-Mart

How do retail stores handle transactions? Wal-Mart has grown to become not just the largest retailer but the largest company in the world. Each store is huge and sells hundreds of thousands of items a day. Each sale has to be recorded with absolutely no errors. Moreover, the store has to monitor sales and choose which products to order. Then it must monitor the progress of incoming items, compare the received items to each order, and resolve problems and errors. Wal-Mart has succeeded because it uses information technology to handle these operations at the lowest possible cost.

A retailer that focuses on low prices can never rest. It must continually search for new ways to reduce costs, improve store management, and choose the correct products to sell at the best price. Being the biggest provides several advantages—notably in terms of negotiations with suppliers. For these reasons, Wal-Mart is one of the companies leading the transition to radio frequency identification (RFID) chips. Initially, Wal-Mart is asking major suppliers to place the passive tags on pallets and major crates. The primary advantage is that the receiving docks can quickly scan incoming shipments and match the products to the individual orders. RFID tags carry more information and are easier to read than traditional bar codes.

Introduction

How do you make money on the Internet? In the late 1990s, the early days of the Web when millions of people first went online, thousands of companies were created to sell items on the Internet. Billions of investment dollars were spent by these firms developing new ways to conduct business on the Internet. Some managers loudly proclaimed the dawn of the "new economy" and the death of "bricks-and-mortar" companies. Most of these early firms focused on selling products to consumers—similar to existing mail order companies. In 2000 and 2001, hundreds of these firms crashed. Some managers then proclaimed the Internet dead. Yet, from the beginnings in the mid-1990s, sales using the Internet have increased—even faster than retail sales in general. The initial "irrational exuberance" (then-chairman of the Federal Reserve Alan Greenspan's term) and consequent crash, highlight the importance of carefully addressing the question: exactly how can you use electronic business to make money? Wrong answers can be costly on both sides: wasting money on hopeless schemes or losing money by not using the Internet.

In the mid-2000s, attention and investment dollars returned to the Internet. This time focusing on firms specializing in new services, dubbed **Web 2.0**. Firms like YouTube, Flickr, Shutterfly, and social networking sites FaceBook and Twitter led the way by attracting millions of members. Following the first-round Web sites, many of these firms received millions of dollars from investors and many provide free access to consumers—relying on advertising to provide a revenue stream. There is no hard-and-fast definition of Web 2.0 firms, but the general distinction is that they provide specific services to consumers. Instead of providing products or information the sites generally provide a framework for interaction, and users provide content.

Trends

Largely because of transportation costs, consumers have been limited to purchasing products through local retail stores. Even for products produced elsewhere, it was generally cheaper to ship items in bulk to the retailer than to ship to individual customers. Plus, manufacturers and wholesalers did not want to deal with individual customers. They did not want to spend the money to create customer-service departments to handle thousands or millions of individual orders, returns, and complaints.

Eventually, shipping and transaction costs began to decline. Sears got its start and made its original reputation as a nationwide mail-order firm. Customers could now order thousands of products from a catalog and have them delivered. Over time, Sears found it profitable to build stores in thousands of cities and moved away from catalog sales. In the 1980s and 1990s, many other mail-order firms expanded to provide thousands of products direct from the manufacturer to the customer. While some people prefer shopping this way, only a fraction of total sales are made through mail-order companies. In 1998, mail-order sales were $356 billion, or slightly over 3 percent of GDP.

Around 1997, sales over the Internet started to become important, and by 1999, e-commerce was the hot topic in the nation. By 2001, over 50 percent of U.S. households had access to the Internet and e-commerce, promising access to millions of customers. Hundreds of dot-com firms were funded with venture capital and early IPOs to define new ways to interact with customers and businesses over the Internet. Hundreds of paper billionaires were created as stock prices were driven by expectations and hype. Some people were saying that bricks-and-mortar traditional firms were dead. But in late 2000 and early 2001, hundreds of the dot-com start-ups failed, laying off thousands of workers and crashing the technology sector of the stock market. Investors are wary, but the Internet continues.

Cell phones began with slow, poor quality analog signals that were gradually replaced with the second generation digital phones by 2000. The third generation wireless phone will handle data and Internet access as well as voice. Portable data access can create new opportunities in mobile commerce to improve contact with customers. Entirely new applications can evolve from virtually immediate contact.

What is electronic business? E-commerce, or EC, can be hard to define. On the one hand, it could be defined as selling items on the Internet. But Figure 7.1 shows there are many aspects to business and many ways of using Internet technologies. Some writers refer to the broader concept as **e-business**. The main point is that EC represents considerably more functions than just putting up a Web site to describe or sell products. The fundamental goal of e-business is to increase sales and reduce costs by improving relationships with existing customers, and by reaching new customers and providing new services.

For at least the past 50 years, companies have followed and refined the modern business practices. These **business-to-consumer (B2C)** foundations were created to facilitate purchasing and distribution in a world with limited delivery systems and high communication costs. For example, retail stores for decades were small

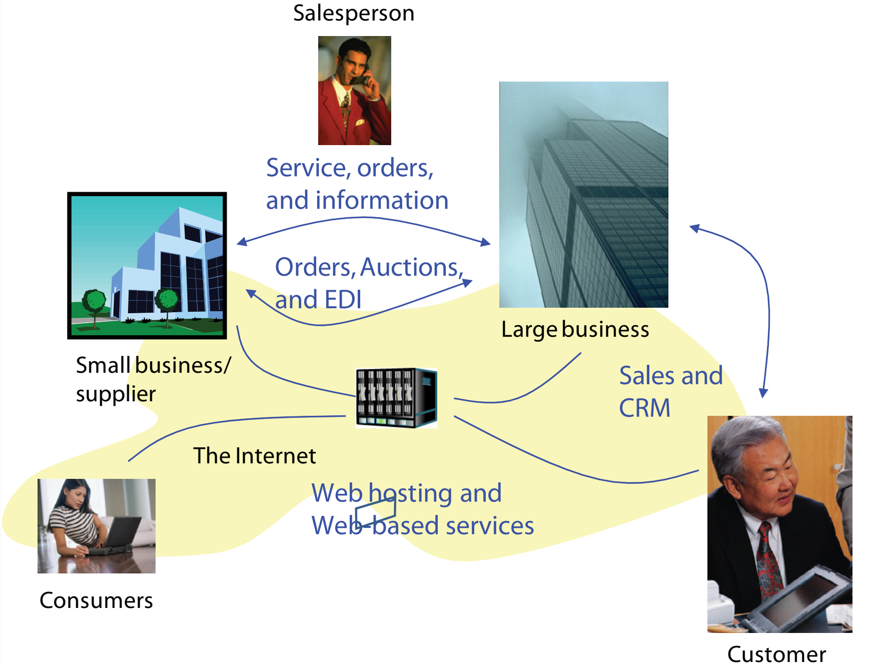


Figure 7.1

Electronic commerce. The Internet is commonly used for sales from business-to-consumer and business-to-business. Salespeople can use it to collect data and communicate with clients and the main offices. New Web-based businesses are being created to provide data and services.

local firms where owners recognized customer trends and ordered a specific mix of products. As manufacturing, transportation, and communication costs changed, some firms were early adopters and began to change retailing. For instance, Wal-Mart took advantage of size in purchasing and distribution to create giant retail stores with a relatively standard mix of products. The Internet provides even more possibilities for change. At a minimum, the Internet makes more information easily accessible to everyone. Now consumer can instantly search for products, obtain reviews, compare prices, and even get feedback from friends. Mobile phones—particularly those with bar-code reader applications—make these features instantly available, even while shopping in traditional stores. The accessibility of this information changes the relationships between consumers and sellers, which should eventually create changes in the way businesses operate.

On the business side, just-in-time inventory and EDI were only the beginning of a revolution in changing the ordering systems of manufacturers. Electronic marketplaces and auctions enable businesses to find new suppliers and obtain supplies on short notice. Sellers can find new customers and negotiate prices without expensive sales visits.

You should remember one important point: EC is not just an issue with new firms. In many ways, existing firms have the most to gain from EC, because they can leverage their existing strengths. **Business to business (B2B)** is also critical

	Business	Consumer
Business	B2B EDI Commodity auctions	B2C Consumer-oriented Sales Support
Consumer	C2B Minimal examples, possible contract employee sites such as rentacoder.com	C2C auction sites (eBay), but many of these are dominated by small business sales

Figure 7.2

E-commerce categories. E-commerce can be considered in the four categories shown. However, B2B and B2C are far more prevalent than consumer-led initiatives.

for existing firms because it can reduce costs and provide new options to managing purchases. Finally, the interactive aspects of EC will become increasingly useful for intranets to improve internal operations and facilitate human resources management.

Figure 7.2 shows a broader classification of e-commerce that includes B2B and B2C as well as consumer-led initiatives. The consumer issues C2B and C2C make up a minor portion of e-commerce. It is not even clear that good examples of these categories exist. Auctions sites, led by eBay, and social networking sites, are probably the best examples of C2C sites. Yet, the bulk of sales on eBay actually originate from small businesses, and consumers do not receive any of the revenue on social networking sites. It is even more difficult to find examples of C2B sites. Probably the best examples are contract employee sites such as vworker.com. Businesses (or sometimes individuals) post jobs online and potential workers submit a price to perform the specified task. Similarly, the job search sites might loosely be considered as C2B.

Eventually, the entire world changes when commerce systems change. But will the economy really change that far? Did the mass failure of the EC firms in 2000 and 2001 really mean that consumers prefer the traditional systems? These are the questions that make life fun and add the risk to entrepreneurship. You must understand the fundamentals before you can create your own answers to these puzzles and help shape the future of business.

Selling Products Online

What types of products are sold online? Selling products online is a natural extension of the catalog sales that existed years before the Internet was created. However, Web-based businesses can provide more pictures and descriptions. Customers can search for products and sizes. It is easier to update the data to provide new products. It is also easy to change prices or to tailor prices for different groups of customers. These factors alone would probably be enough to encourage more people to purchase goods online, but would not likely result in a huge gain in sales. Yet, as Figure 7.3 shows, U.S. Web sales increased by an average growth rate of over 22 percent from 2000 through 2010, according to

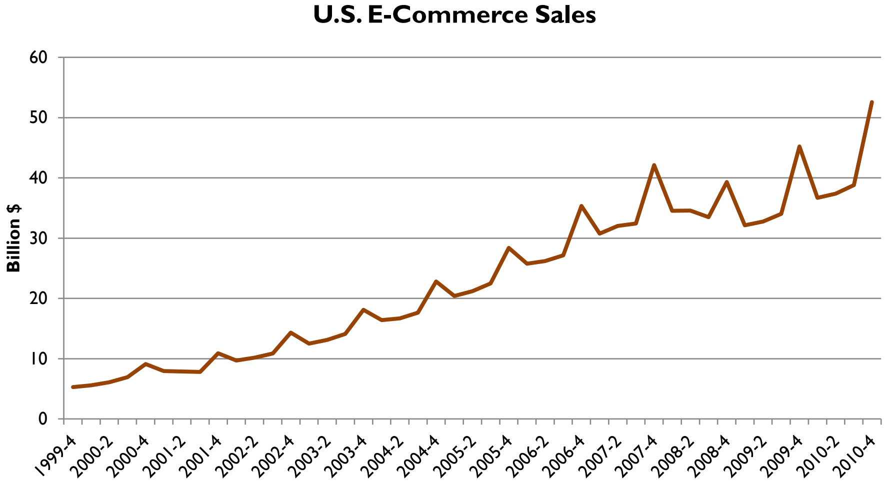


Figure 7.3

U.S. e-commerce retail sales. Census Bureau data show a 26 percent average annual increase. Sales for 2006-Q4 were 3.4 percent of total retail sales. Fourth quarter sales average about 31 percent of annual sales for e-commerce, compared to about 26 percent for total retail sales.

US Census Bureau data. In the fourth quarter of 2010, Internet sales comprised 5 percent of the total retail sales. Not enough to proclaim the demise of bricks and mortar stores, but a higher growth rate than expected from simply replacing mail order sales. Note that the Census data does not include travel, financial services, or B2B sales. One possible reason for the high growth rate might be the ability of the Web to help customers find products and compare prices from multiple vendors. Or, perhaps people simply want to purchase items from the comfort of their homes. However, even if the high growth rate continues, it would take at least 25 years for EC sales to catch up to retail sales. And, some products and services are unlikely to ever be purchased online. On the other hand, the Internet is heavily used for research even if the product is not purchased online (consider housing and automobiles).

To put the EC sales numbers in perspective, it is useful to consider one other piece of data. In the fourth quarter of 2010, Amazon reported sales of $12.95 billion in their annual report. Compared to the total EC sales for that quarter of $52.6 billion, Amazon alone had almost 25 percent of the online sales! Some of Amazon's sales revenue comes from services, but the percentage is relatively low. This large share partially exists because EC sales are still relatively new, and partially because Amazon handles retail sales for many other companies.

Business to Consumer

When asked about e-commerce, most people think of B2C. Everyone is a consumer, and it is easy to think about purchasing products and services over the Internet. But how is e-commerce different from traditional sales methods? And are there some products that people will not buy online?

Reality Bytes: Amazon Expenses

In November-December 2009, U.S. e-commerce retail sales not including travel hit a record $32.6 billion, or an increase of 12 percent from 2008. For the fourth quarter of 2010 (October-December) Amazon's revenue was $12.95 billion, for an increase of 36 percent. Think about those numbers for a second. Even assuming the U.S. sales for October were similar to the November and December values, Amazon captured over 25 percent of the U.S. online sales (not counting travel). To support its continuing expansion, Amazon added 13 distribution centers in 2009, giving it a total of 52 sites. These costs have impacted Amazon's profit, and the company's profits increased only 8 percent compared to the 36 percent increase in revenue. Some of the growth is fueled by digital products such as e-books, which now account for more sales than print books at Amazon. In other cases, simple convenience and searches encourage customers to shop online. Meaghan Keane, a Fairfield, CT nursing student noted that she did all of her holiday shopping online because "I was able to find all these different items that I wouldn't have even known where to look for in stores."

Adapted from Stu Woo, "Expenses Eat at Amazon's Profit," *The Wall Street Journal*, January 28, 2011.

A couple of simple rules dominate marketing. First, consumers prefer instant gratification. Given a choice, with everything else equal, consumers will choose the product at hand over one that will be delivered later. Related to this rule, consumers will often buy items on impulse—simply because they are available and enticing. Second, consumers will prefer to pay a lower total price. While this rule seems obvious, it can be difficult in practice. Consumers need to know that the products being compared are equal. They need to know what other products or suppliers exist and their prices. And they need to be able to compare total prices (including taxes and transportation). Third, consumers prefer to see and touch many products before they buy them. The real challenge in marketing is analyzing the trade-offs when all conditions are not equal.

Food, Clothing, Housing, and Transportation

In many ways, traditional products are the least likely to be successful in e-commerce—at least initially. Consider the four basic items on which people spend most of their income: food, clothing, shelter, and transportation. Distribution is the most critical issue with food. In the 1960s, when people lived closer together in central cities and small towns, neighborhood grocery stores provided basic food items within a short distance of many people. Yet these stores were inefficient because they could stock only a limited number of common items; and the delivery and inventory costs were high. Ultimately, large grocery chains that used their size to hold down costs, provide a large selection, and negotiate favorable terms with suppliers replaced the local stores. Consumers had to travel farther to these new stores, but they were willing to accept the distance to reduce costs. Small local stores were driven out. The two initial leading firms to sell groceries over the Internet were Peapod and Webvan. Customers placed orders on the Web site and drivers dropped off the purchases at a scheduled time, usually the next day. Customers paid a delivery charge for the service. Neither company was very successful in terms of profits. The increased costs, delivery time, and lack of ability to touch the items discouraged customers.

Reality Bytes: JCPenney's Gets Caught on the Dark Side

Search engine optimization (SEO) has become a popular topic among online vendors. The goal is to obtain as high a ranking as possible on Google and other search engines. If a site ranking closely matches a search term, it will be displayed at the top of the page automatically; without paying any money to Google. Some people spend a huge amount of time trying to determine how the search engines work. A few people spend huge amounts of time trying to figure out how to game the system and obtain a high ranking for their pages. But, trying to deceive the search engines is always a bad idea. Google succeeds only by returning accurate matches and deception can result in punishment. JCPenney's, an American department store, found out the hard way in 2010/2011. For several months in 2010, JCPenney's was at the top of the result lists for many products and even manufacturers. Apparently, the retailer tried every trick in the book to get its site listed first for hundreds of items—using methods that crossed the line to the dark side of SEO. Doug Pierce, an expert in searches, examined some of the company's practices and noted that "Actually, it's the most ambitious attempt I've ever heard of. This whole thing just blew me away. Especially for such a major brand. You'd think they would have people around them that would know better." Eventually, Google altered its algorithms and also punished JCPenney's by forcing all of its entries to be buried several pages deep in the results. JCPenney's fired its SEO consultant. Google uses on links from other Web sites to help determine the content and importance of a site. Open Site Explorer helps identify when sites contain links to any given page. JCPenney's was paying people to post links to its pages. Google's terms of service allow it to punish any company it feels is not playing fairly. JCPenney also spent money on Google ads—as much as $2.4 million a month. In 2006, Google penalized BMW for using a black-hat SEO strategy and basically removed the company from its search results. Overstock.com was similarly punished with a two-month downgrade in 2011 when Google found that Overstock was paying students to put links on their Web sites.

Adapted from David Segal, "The Dirty Little Secrets of Search," *The New York Times*, February 12, 2011; and Julianne Pepitone, "Why Google Threw Overstock in the Penalty Box," *CNN Online*, April 25, 2011.

A second way to look at EC and food is to realize that few families cook their own meals. Takeout from a variety of restaurants and even grocery stores is a popular substitute. Many restaurants—particularly pizzerias—deliver food on short notice with just a phone call. Would there be a reason to convert the phone system to an Internet connection? A few places do this, but many people still prefer phones. Theoretically, the Internet can provide menus and it is better at handling multiple customers at the same time. Furthermore, it could be used to provide feedback to the consumer—in terms of status of the order and when it will be delivered. But most restaurants are small businesses, and they have resisted building the infrastructure to provide these features.

Clothing offers more prospects for e-commerce. Selection is always an issue with local stores. No matter how large the store, it can carry only a small, targeted selection of styles and sizes. And larger selection means greater inventory costs. So, there is room for an EC firm to sell a wide selection of products across the nation. In fact, several catalog mail-order firms concentrate on these markets. These

Reality Bytes: Nestle v. Red Cross Tweets

Corporate marketing started to fall onto the social networking bandwagon by 2010. The adoption of Twitter made it temptingly easy to create a social image. Companies hired individuals and marketing firms to spread the news about the companies online. But, image is something that can be fleeting or at least easily affected by even simple mistakes. In 2010, Greenpeace convinced people to flood Nestle's Facebook page. Greenpeace objected to Nestle's use of palm oil which allegedly impacts habitat for orangutans. The organization encouraged supporters to flood Nestle's Facebook page and use profile pictures of altered Nestle logos. The person running the Nestle page responded by posting statements about taking down the negative comments. The response angered thousands of more people and the floods escalated. Eventually, the Nestle representative offered an apology, but the incident did not help the company's image. In contrast, someone @RedCross posted an accidental tweet "Ryan found two more 4 bottle packs of Dogfish Head's Midas Touch beer…when we drink we do it right #gettngslizzerd." An official response came quickly from @RedCross with the tweet "We've deleted the rogue tweet but rest assured the Red Cross is sober and we've confiscated the keys." Dog Fish beer fans latched onto the #gettngslizzerd hashtag, and breweries and pubs in many states launched beer-for-blood offers, increasing awareness and donations to the Red Cross. Other examples of good and bad responses exist, and new ones are likely to arise. Few rules exist in social networks, and tastes change. But, building a loyal following and using light humor are generally good ideas—particularly when something goes wrong.

Adapted from Julianna Pepitone, "6 Painful Social Media Screwups," *CNN Online*, April 7, 2011.

mail-order companies have also been relatively successful at e-commerce. The one problem is that clothing sizes are not quite standardized. Hence, many shoppers—particularly women—prefer to try on clothing before purchasing it. Some leading sites like Lands' End have implemented electronic virtual models that enable customers to select items and see how they might look. But many people prefer touching the individual garments first. Still, the ability to search for styles and sizes makes the Web a useful tool. And many consumers learn to trust certain brand names, so they search the Web for those specific brands.

Finding a home is always a difficult task. A medium-size city might have thousands of homes for sale at one point in time. It is hard to find and compare all of the details. The Internet has helped in some respects. Searching is an important strength of the Internet. Several real estate databases exist online to retrieve house listings based on a variety of items. However, almost no one would buy a house without seeing it in person; so the role of the Internet is limited. At first glance, it would seem that real estate might be a prime opportunity for e-commerce. Real estate commissions are often priced at 6 percent of the sale price, which can be a high value for expensive houses. So there should be strong incentives for removing the commissioned agent from the middle of the transaction. But buyers often prefer to use agents. Real estate agencies control most of the housing market data and they have resisted moving to an online world—particularly one that might result in a reduction in the commission rates. However, the Zillow.com site offers several interesting features that might enable it to encroach on the traditional retail listings.

Reality Bytes: Even the Best Fall Down Sometimes

As an early adopter and leading e-commerce company, Amazon runs one of the most sophisticated cloud-hosting services on the Internet. Several big-name Web-based companies rely on Amazon's servers to run their operations. On April 21, 2011, Amazon suffered a collapse of its internal network in its East Coast facilities. The disruption knocked out or slowed service to Internet service firms such as Foursquare, Reddit, and Quora. Despite early optimism, it took Amazon engineers several days to fully restore service. Amazon posted a detailed explanation of the problem after the site was restored. Interestingly, the problem arose partly because of the redundancy built into the EC2 facilities. A misconfigured router shifted traffic to a slow internal network and datasets were unable to connect to their replica backups. Even when the router configuration was fixed, essentially every dataset tried to re-establish a new backup copy—flooding the data controllers. With this knowledge, Amazon began rebuilding its systems to prevent similar problems.

Adapted from Shara Tibken, "Amazon Cloud Snafu Disrupts Websites," *The Wall Street Journal*, April 21, 2011 and http://aws.amazon.com/message/65648/.

Transportation is more interesting because it can be a product (automobile) or a service (airplane or subway ticket). Airlines have done well with direct e-commerce sales. Yes, they have offended the traditional distribution channel (travel agents), but the people who travel the most have been willing to purchase tickets directly to save money and gain control over their choices. Today, almost all airline tickets are sold online.

Automobiles are more interesting. Few people are willing to buy new automobiles over the Internet, but Web sites offering searches for specific used cars are popular. Part of the difference is that consumers have greater bargaining power with used automobiles than with new ones, so the increased information on available cars gives them more leverage. If one owner or dealer offers a high price for a specific car, you can quickly find another one. New cars are more challenging because of the strong relationship between the few manufacturers and the dealers.

Most people want to test-drive a car before they buy it, so the manufacturers have a strong incentive to keep the dealer network. Many insiders also believe that the salesperson is critical to selling cars, by overcoming objections and talking people into buying cars when they hesitate. So, if dealers and showrooms are necessary, what is the value of e-commerce in selling a car? Both General Motors and Ford have experimented with online sales of new cars, with minimal success. Currently, the auto manufacturers prefer to sell through the dealers. A few states actually have laws that prohibit auto manufacturers from selling directly to the public. While the manufacturers want to keep the advantages of the dealers, they also want to find a more efficient method to distribute cars. Manufacturers have talked about an Internet-based build-to-order system, where customers could select options and cars would be made to order. A few larger regional dealers would maintain basic inventory to support test-drives. The advantage of this system would be to reduce inventories and enable manufacturers to build only the number of cars that are needed. The main drawback is the difficulty in configuring assembly lines quickly enough to hold costs down.

On the other hand, used cars present a different situation. Buyers have embraced the Internet as a method to locate used cars and compare prices. Sellers find it a useful tool to avoid the high prices of newspaper advertising—particularly since it is inexpensive to place photos on Web sites.

The point of these examples is that without substantial changes in behavior, people will continue to prefer the traditional sales mechanisms. Particularly since these mechanisms have proven to be relatively efficient—or closely controlled by a group with a strong interest in maintaining the current system.

Product Characteristics for Online Sales

So, is the world really so bleak that B2C e-commerce is doomed to fail? What about Amazon.com, one of the larger retailers on the Internet? By selling commodities, they avoid the problem of choosing products. The latest best-selling novel is the same regardless of where it is purchased, so consumers do not need to see and touch it before purchasing it. Besides, Amazon.com can offer a wide selection of titles. It can also make it easier to find books and does a good job offering related products that might interest the consumer. But the concept is still hobbled by the distribution problem—it takes time to deliver a book or CD to the customer. So, online vendors like Amazon.com compensate by offering larger selections than those found at a traditional local store. Amazon also discounts some items to encourage people to accept the delivery delay. But, to achieve profits, around 2003, Amazon began charging list price for mass-market paperback books—which represent a substantial percentage of most book sales. Amazon has also been one of the leaders in the switch to digital books—largely by offering their own e-book reader (Kindle) at declining prices.

To find successful B2C strategies, you need to look at the features that the Internet provides that are superior to traditional stores. The most important ones are the: (1) search technologies, (2) ability to quickly compare multiple products and vendors, (3) low costs for large amounts of information, (4) ability to reach a wide audience, and (5) ability to tailor responses to individual customers.

The essence of a profitable Web site for products is to identify items that can benefit most from these features. For example, specialty products can be hard to find. A few firms could reach a national audience using EC and capture most of the market by being easy to find and offering competitive prices. Another approach is to offer products with many options that require customization. Dell has been successful at selling computers over the Internet by making it easy to configure and compare prices and by using modern production technologies to hold costs down so that the EC solution highlights their prices.

Look at the EC sales data one more time and realize that almost one-third of the sales take place in the fourth-quarter, year-end, holiday shopping season. People are searching for specific items. They might want unique items, or they might search based on availability or the lowest price. Of course, the types of items that fit these categories are also items that are likely to be purchased online during the rest of the year.

Business to Business

Business-to-business e-commerce has the potential to be more important than B2C e-commerce. First, businesses tend to buy repeat items in bulk, so they do not need to test-drive or touch every product. Second, medium and large businesses already have high-speed connections to the Internet and rely on computer systems in their daily operations. Third, costs are becoming a driving factor, and technology can reduce the transaction costs and the number of errors.

Extended EDI

By simply offering the ability to sell products to other businesses, the Internet can be used for EDI. For materials and components that are purchased on a regular basis, EDI software can connect across the Internet to automatically monitor inventory and send orders to the appropriate company. For less frequent purchases, a buying firm could set up software to scan servers for prices, select the appropriate items, and place orders automatically.

Currently, few systems work this efficiently. Most require a human to collect data and place orders. Web sites make it easier to collect data on prices and availability, but every site has different search methods and different purchase screens. EDI software helps by following standards, but the companies involved must install and configure it. XML is a more flexible method of sharing data with suppliers and customers. Eventually, the technology can be married with expert systems to provide more automated intelligence to handle ordering basic items and to monitor the progress of standard orders.

Some companies, such as Office Depot, have leveraged the Web to lock-in business customers. Companies sign up with Office Depot and employees place orders for office supplies directly on the Office Depot Web site. Office Depot delivers the products on a daily basis and bills the company for all purchases. It is not exactly EDI, but a simpler method to connect directly to customers. Most ERP systems provide these capabilities, so almost any business can create Web sites that enable business customers to order directly.

Auctions

From an economic perspective, B2B auctions are one of the most exciting tools created through e-commerce. In the past, companies purchased materials and supplies from a complex set of distributors and wholesalers, driven by in-person sales calls. Within this context, most manufacturers dealt with only one or two suppliers for each part. To hold down transaction costs, it was simpler to establish long-term relationships with a limited number of companies. Of course, it made it harder to ensure that the buyers were getting the best price. Competition helps hold down prices during the initial contract negotiations, but if anything changes in the ensuing year or two, it is difficult to renegotiate the contract. But in exchange, the buyer gains a more stable environment.

Economic theory shows that well-run auctions are the most efficient way to establish an efficient market price. To be well run, the auctions have to be open to the widest range of participants, and everyone must have complete information on the items and prices. Several industry-specific auction sites have been established. One of the more successful sites involves the steel industry. Significant amounts of steel are still sold directly to manufacturers on long-term contracts. However, the auction sites make it easier for suppliers to unload specialty and overstocked inventory in a spot market. The auctions also give manufacturers the ability to monitor the spot market and availability of steel products, so that they can quickly pick up additional quantity.

For commodity items, auctions can hold down prices by improving competition and making price and quantity data available to all participants. Auctions are also useful for specialized products, when it is difficult to determine an asking price.

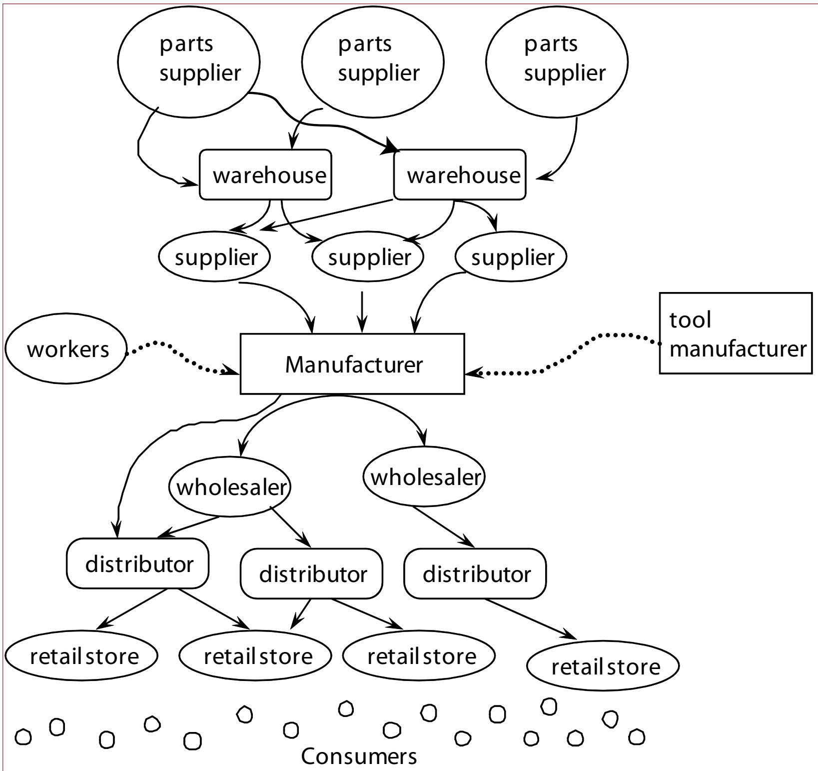


Figure 7.4

Production chain. The production chain is important to EC because EC offers the ability to skip elements of the chain. It also makes it easier to reach new customers at any level in the chain.

Some companies have found that they can obtain higher prices for their products when they sell them at auction. Also, auction prices can change easily, so if there is a short-term jump in demand for your product, you will be able to capture the additional profit. Of course, you might have to accept lower prices the next day.

The Production Chain and Disintermediation

What problems might arise from shifting sales to the Internet? To understand the issues in EC, you must first understand the production chain. Shown in Figure 7.4, the strategic effects are important to EC. One of the key aspects in B2C e-commerce is the ability to bypass entire sections of the production chain. Consider the situation of airlines. In the 1960s and 1970s, airlines created giant reservation systems to handle flight bookings. The system consisted of the airlines' massive central computers and databases and travel agent terminals connected by a custom network. It was too expensive for customers to connect directly. Also, the systems were hard to use and travel agents needed special training. Agents were paid a commission based on the value of the flights booked through the reservation system paid by the airlines. With the advent of frequent-flyer miles, airlines encouraged consumers to book flights with the airline itself, bypassing the travel agent and saving the cost of the commission. But it is difficult to search for flights using

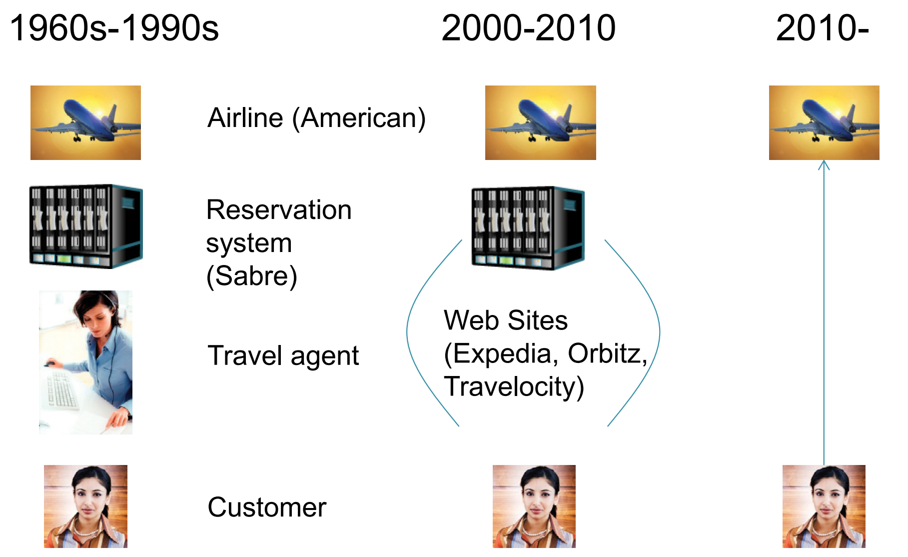


Figure 7.5

Airline industry disintermediation. Partly because airlines sell a perishable service, and partly because of the role of information (reservation), they have led the way in finding ways to connect to customers. Web sites initially supplanted travel agents, but the Web sites were controlled by the original reservation companies. To reduce fees, airlines (led by Southwest and American) bypassed the reservation systems and require customers to work directly with the airline.

the telephone. The Internet changed everything. Several travel sites and the airline sites themselves make it easy to find flights, compare prices, and purchase a ticket any time of day without the assistance of an overworked travel agent or salesperson. Tickets are merely electronic reservation numbers, where you simply show appropriate identification at the airport. On the production chain, the airlines (as service providers) bypassed the intermediaries to sell directly to the consumer—a process known as **disintermediation**.

As shown in Figure 7.5, for a few years, most of the airline industry relied on a few companies to provide data and reservation services to various Web sites. These companies were the same reservation systems originally created by the airlines, including Sabre created by American Airlines, and spun off. In 2010, the disintermediation extended further when American Airlines, in a dispute with the reservation companies (including Sabre), pulled all of their data from the online systems and required customers to book online directly with the airline. Southwest Airline had long followed a similar practice—to avoid the fees paid to the reservation companies. One effect of this change is that it is more difficult for consumers to find and compare flight costs. If all airlines require individuals to connect directly, a search would require checking every airline separately. Eventually, a consolidator might be able to search and display data from multiple sites, but the airlines will be reluctant to pay the fees, so the consolidator would have to find another way to make money.

Production Chain

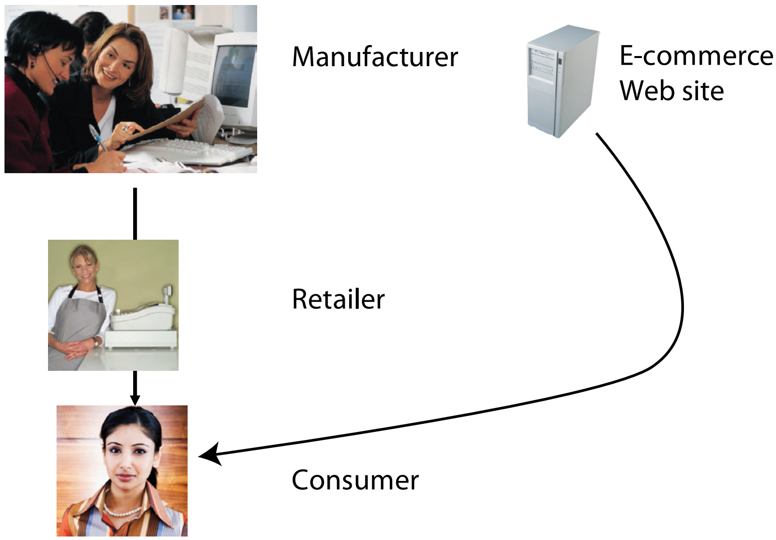


Figure 7.6

Disintermediation. The traditional production chain evolved because separate firms provided specialized functions more efficiently. E-commerce reduces costs and has the potential to circumvent various intermediaries. But disintermediation is a risky strategy.

A similar process can occur in manufacturing. Instead of wholesalers, purchasing agents and suppliers are forming B2B auction sites. Companies can sell or buy products and materials on a variety of Web sites. Instead of searching out buyers or sellers, businesses simply submit a bid on a Web site that covers the desired product.

Today, it is rare for a company to be vertically integrated across the production chain. For example, most manufacturers rely on other firms to handle distribution and retail sales. In a sense, they choose to outsource these functions because of the costs. Over the last 50 years or so, firms have worked to become more efficient within their niche. As shown in Figure 7.6, e-commerce has the potential to change these relationships. By reducing the costs of dealing with individual customers, it becomes possible for firms to circumvent the retailers and sell directly to the end consumer. Since retail price markups can be in the range of 100 percent, the manufacturer has a strong incentive to sell directly to the public to capture some of this additional profit.

However, particularly in these early days of e-commerce, many manufacturers are reluctant to remove the retail role. Taking sales away from the established retail channel could alienate the retailers, who are currently responsible for almost all of the sales. If retailers decide to drop your product, and consumers are slow to switch to direct purchases, you may lose the market.

Interrelationship with the existing retail distribution channel is a critical factor in any e-commerce strategy. Removing an intermediary can increase your profits

Prepurchase	Purchase	Postpurchase

Static data sites
    Promotion
    Product specifications
    Pictures
    Schematics
    Pricing
    FAQs
Interactive sites
    Configuration
    Compatibility
    Complex pricing
	Transmission security
	User identification
	Product selection
	Payment validation
	Order confirmation
		Service
		    Problem tracking
		    Sales leads
		Resolve problems
		Answer questions
		Product evaluation
		    Modifications
		    Tracking customers

Figure 7.7

Electronic commerce. Websites are commonly used to support the three main phases of marketing.

and can be used to reduce prices to capture more market share. But is the intermediary a critical component? Will your sales remain if you remove it? Are customers ready to switch to direct purchases? Some firms attempt to do both: keep sales through traditional channels and also provide direct e-commerce sales through a Web site. But they minimize competition and appease the retailers by charging the suggested retail price on the Web site. So, consumers can often find the product cheaper at a local store—which is willing to offer a discount on the list price.

In some situations, the reliance on the retail channel leads to strange conclusions. In early 2001, Compaq was producing a popular PDA with a color screen. But Compaq had trouble with production and demand was substantially higher than supply. Consequently, few retailers carried the product. Some of the businesses that were able to obtain the product did not bother to sell it at their local stores. Instead, they auctioned the units individually on eBay for several hundred dollars over the list price. Would Compaq have been better off auctioning the PDAs directly to consumers?

Three Stages of a Purchase

How do you use the Internet to market goods and services? From a marketing perspective, the buying process has been defined in three basic steps: (1) prepurchase information gathering, (2) the purchase itself, and (3) postpurchase support. Figure 7.7 lists these steps with examples. The Internet can support each of these areas. The level of support in each area depends on the industry, type of product, and capabilities of the customers. Note that the process differs depending on whether the customer is a retail consumer or another company. For example, sales to other companies are generally repetitive and typically require additional documentation and billing procedures.

In many ways, the purchase issue is a minor component. EC purchases currently offer only minor benefits compared to traditional phone orders. The main benefit to EC lies in providing additional support to customers before and after the sale. In particular, intelligent Web sites supported by expert systems can help customers select options and products or solve problems. For fixed development costs and relatively low monthly fees, the online systems can provide 24-hour

Figure 7.8

Barcode search. Most smart phones have barcode scanning apps that use the camera to capture the barcode, send the number to a Web server, search for the item and return sites and stores with prices for that item.

support. Sales can be increased by providing more detailed information, helping customers customize their selections, and using an expert system to build cross sales. Costs are reduced because the system is automated. Sales and costs can be further improved by providing after-sale support. Expert-system guided support can help customers solve problems faster. Any product design or production problems can be reported directly, giving you the chance to fix the product before it ships to more people.

Price Competition

A primary concern expressed by many firms investigating e-commerce is the issue of price. The Internet makes it easy for people to search vendors and compare prices. This process is particularly easy for products that are the same (such as books, videos, and electronic equipment). For example, Google (www.google.com/products), Bing (click the Shopping tab), and several other sites offer searches for products that display prices and availability for a variety of products. As shown in Figure 7.8, several cell phone apps even provide the ability to snap a picture of a bar code and look up online prices. Consumers now have easy methods to obtain more information.

However, merchants are concerned that people will compare sites based only on price. Availability of the item will also make a difference. Why are merchants concerned about price competition? First, the existing retail product chain was originally created so that retail outlets could provide personalized service and product information to customers. Vendors survived and grew based on their ability to provide customized information and support to local areas. Competing purely on price and availability changes the rules and requires a different type of merchant system. Second, if customers look only at price and availability, it is easy for a new firm to enter the market. The new firm simply slashes prices and sells products at a loss to attract customers. Of course, in the long run, the firm will fail—but so will the other firms. Economists can assume that managers and owners are intelligent and will eventually learn to charge a price that does provide a profit. But it might take time for this new economy to evolve. This fear of irrational firms does have an element of truth. Amazon gained its market position primarily by offering substantial discounts on books. In fact, Amazon's finance

Reality Bytes: Dr. Pepper's Social Networking

It took Dr. Pepper several years to build a base of 8.5 million fans on Facebook. But, the investment pays off. The company uses the group for test marketing. Each day, the company puts out two messages on its Facebook fan page and then it tracks and evaluates the responses. New York based Code & Theory created custom code to measure how many times a message is viewed and how often it is shared with other users. Robert Stone, director of interactive media services for Dr. Pepper Snapple Group Inc. notes that "We mine the data to understand what is appreciated, and what is not." One thing the company learned is that diehard Dr. Pepper fans like edge one-liners. For instance, the company heavily promoted the phrase "If liking you is wrong, we don't want to be right." Through Facebook, Dr. Pepper gains fast feedback to concepts, along with free marketing when fans spread the ads to their friends.

Adapted from Geoffrey A. Fowler, "Are You Talking to Me?" *The Wall Street Journal*, April 25, 2011.

officer made the remark in 2000 that he was surprised people were criticizing Amazon for not making a profit. He said that Amazon never intended to make a profit on sales. However, after the crash in e-commerce stock prices, Amazon has worked harder to cut costs, and has increased prices on many items to achieve a profit.

Initially, the largest impact of Internet price competition will be on the retail firms. By minimizing the aspect of location, the primary strength of local firms is eroded. If customers are willing to wait for products to be delivered, then there is no longer a point in having thousands of small local stores. But that "if" is huge. The ultimate economy will depend on consumer preferences between price and the ability to receive a product immediately.

A ruling by the U.S. Supreme Court in 2007 could ultimately affect the degree of price competition on the Internet. In *Leegin Creative Leather Products v. PSKS Inc.*, the Court ruled 5-4 that in many cases manufacturers could enforce minimum retail prices for their products. Although the case did not directly involve the Internet, one of the issues manufacturers face is that customers might go to local stores to check out products and get advice and service. But the customer might then turn to the Internet to purchase the product at the lowest possible price. Effectively, the local store does the work but loses the sale to a store that provides minimal service. The effect of the controversial ruling remains to be seen, but the most likely impact is fewer discounts available for customers. Or at least it will be more difficult to find the discounts.. to obtain more information.ture the barcode, send teh icesut the airlines will be reluctant to

A few e-commerce firms have attempted to use the interactive features of the Internet to set prices dynamically. In an experiment, Amazon.com charged different prices to different customers. It appears to have been a relatively standard attempt to statistically evaluate price sensitivity to various products. However, when customers learned that others had obtained the same product for a lower price, they complained. Yet, in traditional stores, customers routinely are charged different prices for the same items—for example, through coupons or negotiation. As shown in Figure 7.9, part of the fear is that the Internet might someday be used to force people to pay the highest amount they are willing to pay, as opposed to

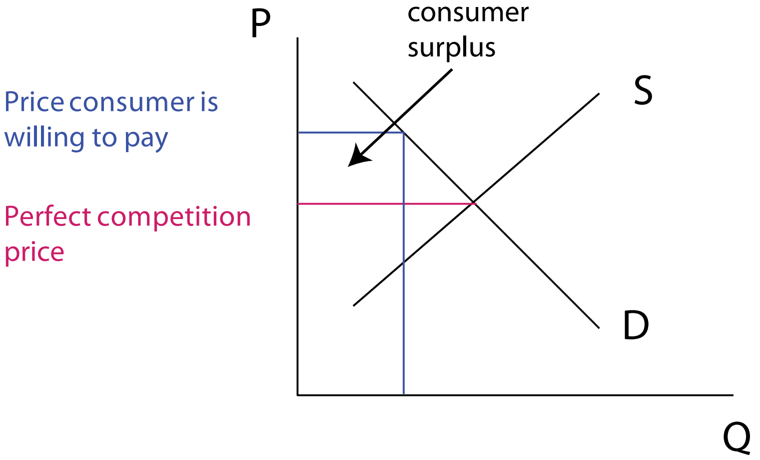


Figure 7.9

Dynamic pricing. The ultimate goal is to set individual prices for each consumer to capture the maximum price each is willing to pay, as opposed to the perfect competition price, where everyone pays the same price, and some customers gain because they were willing to pay more.

perfect competition price. At a perfectly competitive price, many customers pay less than the maximum amount they are willing to pay, providing them with a consumer surplus. If vendors can charge the maximum price to each person, the company can capture some, or all, of the surplus resulting in higher prices for consumers.

Services and Web 2.0

How do Web-based services work and why do they change the world? As households and businesses obtain higher-speed connections, new Web-based services become possible. You have probably heard about some of the consumer-oriented sites such as YouTube, Facebook, and Flickr. Other sites offer more sophisticated services to businesses. For example, several companies provide online accounting or even ERP services such as customer relationship management. The purchasing companies pay a monthly or annual fee to use the applications. All of the processing and data storage is handled by the providing company, leaving the customer firm free to ignore the technical issues and focus on running its own business. Some companies, such as Google, provide applications such as a word processor, spreadsheet, and communication systems that can be used by both individuals and entire organizations. A third important category of services relates to the Internet itself: providing network access, developing new applications, and hosting applications on servers.

Social Networking and Consumer Services

YouTube, Flickr, FaceBook, Twitter, and similar **social networking** Web sites led the service revolution for consumers. These applications provide new tools for people to interact with each other, offering more reasons to spend time online. Most of the consumer-oriented sites do not charge customers to use the applica-

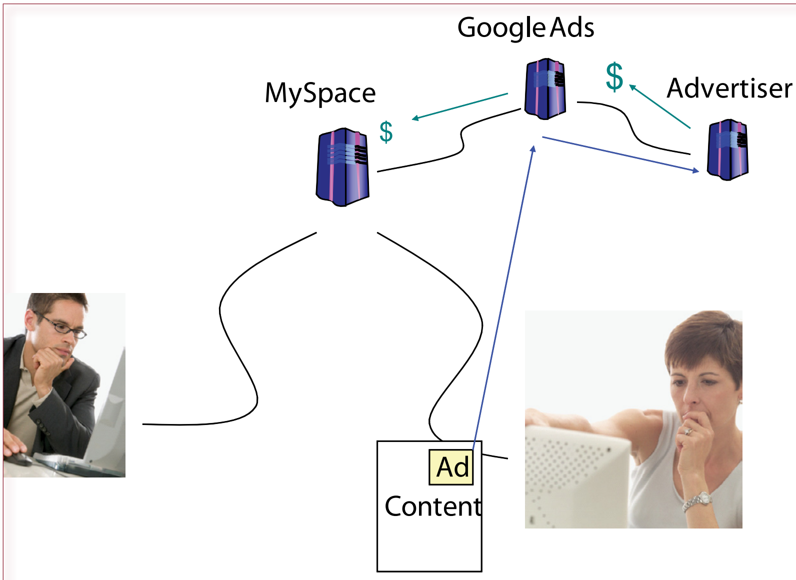


Figure 7.10

Free content supported by ads. Sites can offer free content by displaying ads delivered through Google or Yahoo. When users click on an ad, the advertiser pays Google, which pays a portion to the original site.

tions. Instead, they make money by selling ads. Consequently, the sites that grow the fastest and attract the largest number of users stand to make the most money. Giving free access helps attract users, but the sites still need to provide a service that users actually want. There are still plenty of opportunities to invent new services that will attract users, but as always, the challenge lies in finding an application that is useful to millions of people. On the other hand, as users gain even higher-speed connections, particularly mobile ones, new opportunities become feasible.

Some Web sites are actually services in disguise. For example, 1800flowers sells flowers, but the company does not grow or ship the flowers. It contracts all of the details to other firms. What the main site really does is keep track of special event days, such as birthdays and anniversaries. It basically provides a reminder service and makes it easy to order products corresponding to those dates.

The challenge with consumer-oriented service sites is to make money. The choices are (1) charge for the service, (2) sell related products, (3) sell advertising space, and (4) sell the service to another company. Many of the failed dot-coms chose option three. When the advertising market crashed, they could not cover their costs and went out of business. Option four is discussed in the business services section. Selling related products is probably the easiest solution today. In this case, the service is simply another feature that will attract customers to your site. But the additional costs can make it harder to compete on the basis of price, so you have to be certain that customers really do value the service. Figure 7.10 shows the basic process of generating money through ads. The Web site (such as Facebook) contracts with Google to display ads on pages. No money is received at this point. Ads are displayed along with the content. If a user clicks on an ad,

Reality Bytes: Fox Broadcasting Sells More Online Ads

Fox Broadcasting, a division of New Corp., announced plans to increase the number of online video ads. The goal is to match the number of commercials in traditional TV broadcasts. Pricing of commercials would also change as the broadcaster strives to combine TV and online audiences into a single group. Toby Byrne, the president of Fox's ad sales noted that "This is what our business is becoming. There shouldn't be a different commercial experience by virtue of which way you choose to watch our content." For early 2011, Fox's traditional prime-time audience share for 18-49 year old viewers had dropped 5.4 percent to 4.6 million. One goal of the new pricing strategy is to capture the number of viewers who watch the show online instead of through broadcasts. Fox is following in the footsteps of the CW joint venture between CBS Corp and Time Warner Inc. who adopted the same approach a year earlier.

Adapted from Sam Schechner, "Fox Shifts How it Sells Online Video Ads," *The Wall Street Journal*, May 16, 2011.

Google tracks the click and directs the user to the advertiser's page. At the end of the month, the advertiser pays Google, and Google pays a small percentage to the original site owner. The site usually receives only a few cents per click, so it takes thousands or millions of clicks to make money. But the site has almost no costs for carrying the ads, so it is easy to experiment with sites to see what brings in money.

Financing and building an ad-based application is a challenge. Revenue does not arrive until the site succeeds in attracting thousands or millions of users. In the meantime, you need millions of dollars to build, host, and market the new service.

Digital Products

This category blurs the lines between products and services. You can buy music as CDs, movies on DVDs, paper books and newspapers. If you buy these items as traditional products, they need to be shipped to you. But all of these products can be sold and delivered as digital products or services that you download immediately. For example, some music sites, such as Rhapsody, provide the music as a service because you only rent the music. If you drop your subscription, the music will no longer play.

Digital products are a field where e-commerce will eventually dominate. Already, many products are stored in digital format: music, news, books, movies, software, and games. In late 2000, many consumers found how easy it was to distribute digital music over the Internet using MP3 files and Napster—even though it was illegal. Digital content over EC meets two of the main consumer criteria: it is instantly available at any time, and costs should be lower since distribution costs are small. Furthermore, digital content is more portable than traditional CDs, DVDs, and books.

The main challenge to digital content revolves around **intellectual property** rights and laws. Digital content can be easy to copy and redistribute—depriving the owners (artists) of any reward. The risk is that free distribution of digital content would remove all incentive for artists and authors to invest time for which they receive nothing.

Several companies (particularly Apple, Microsoft and RealNetworks) have developed **digital rights management (DRM)** systems to prevent unauthorized copying. Microsoft and a couple other companies have systems in place for books. Most systems take advantage of the Internet. When a consumer purchases a digital product online, the purchase is recorded in a digital rights management server and issued a unique ID. From this point, the systems vary. Some work by periodically checking the Internet server as the product is used to verify that it is an authorized copy. In some systems, the generated ID can work only on the computer for which it was first created, so giving the file to someone else does not allow it to be played or viewed. Some systems enable users to transfer rights to another person; others do not.

Another challenge with digital products is the payment mechanism. The transaction costs on credit cards and checks are too high to enable low-price purchases, such as buying one song for a few cents. Until micro-payment systems become accepted, it is difficult for sites to charge for content. Currently, subscriptions are the most common solution. One of the more successful sites is *The Wall Street Journal*, which charges an annual subscription fee to several hundred thousand subscribers. And even the *Journal* admits that it has difficulty preventing people from paying for one subscription and sharing it (although that would be in violation of the subscriber agreement).

One difficulty with any protection system like the digital rights management schemes is that it is difficult to stop someone from breaking the system. Early software vendors in the 1980s learned the lesson that copy protection schemes were routinely defeated and removed. However, the digital millennium copyright act (DMCA) in the United States makes it illegal to break copy protection schemes. As a relatively new law, it remains to be seen whether this condition can be enforced. Also, the law does not apply to people outside the United States. DVD vendors pursued this issue in 2000 and 2001 when a group broke the encryption scheme used to slightly protect DVD movies. The Motion Picture Association of America (MPAA) has sued several companies in the United States for even linking to sites that list the decode algorithm, but the code remains on thousands of sites around the world. A major question exists in terms of whether copy protection schemes can survive. In 2007, Steven Jobs at Apple began pushing the recording publishers to enable Apple iTunes to sell music without DRM. In general, customers do not like DRM because it limits how the content can be used. In Apple's case, songs purchased on iTunes can be played only on the Apple hardware; and DRM-protected songs purchased from competing sites cannot be played on that equipment. Protecting content has been one of the biggest hindrances that has delayed the introduction of many services, including downloadable videos and books.

Business Services

Providing online services to businesses is similar to providing services to consumers, except that the services differ and it is easier to charge other companies for using the application. Services can be as simple as providing direct applications such as ERP or e-mail. However, the Web infrastructure has the ability to support distributed services, where companies provide various pieces of a Web page—which appears to the consumer as a single integrated page.

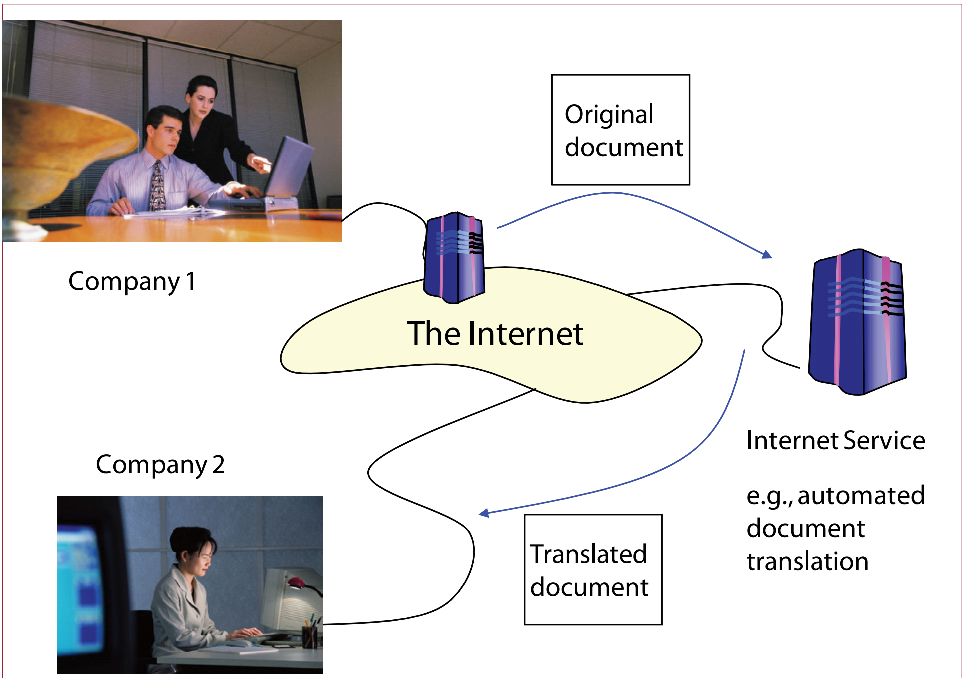


Figure 7.11

Distributed services. Firms can offer digital services over the Internet to other companies, such as document translation or reservation handling. With XML, the process is relatively automatic and can be billed for one-time and limited uses.

Applications

Many of the applications are aimed at small to medium businesses that lack the resources to pay huge upfront costs to purchase expensive applications. For instance, several companies provide online ERP services. Smaller companies configure their accounting systems and employees access the system through Web browsers. Since everything is Web based, it does not matter where the application is hosted. And, the smaller company can rely on the service provider to keep the servers running, provide backups, and monitor security threats. Salesforce, the leading customer relationship management system runs purely as an online service. Companies pay by the month or the year based on the number of employees using the system. Companies can expand or contract their usage by purchasing access for additional employees.

Google has purchased several companies to provide even more online service applications to businesses (and consumers). An e-mail and calendar communication system was the first main application. Companies simply pay an annual fee to maintain all of their e-mail on Google servers. They get to use their own domain name (as opposed to gmail.com), and Google handles all of the servers, backup, and security issues. Google (and other firms) also offer online service applications to handle word processing, spreadsheets, and slide show applications. Although they lack some of the features of standalone packages, basing them on a central server makes it easy to share the data created with other team members. For instance, someone in marketing can write a marketing plan. By simply assigning permissions, other employees in the company can work on the same file—from anywhere in the world.

Distributed Services

XML and other standards create opportunities for a new type of B2B e-commerce. Web sites can provide specific automated services that can be sold to other businesses. One example would be a Web site like Altavista (babel.altavista.com) that has an automated document translator. Figure 7.11 shows the basic concepts. The key is that the services are automated and simply called from your Web site. This arrangement is actually more of a peer-to-peer system than a client-server technology. You can create a Web site that uses services from many different companies. For example, you might create a Web site that pulls current stock price data from one site, performs some complex financial calculations on a second site, and converts currencies using a third site's exchange rates. All of these activities happen behind the page, so your users see only the final application.

The main advantage to this type of system is that experts can build objects and maintain and run the services on a Web site available to anyone willing to pay the service fee. In many cases, the service fee could be a small per-usage value. So you could build a composite application that has state-of-the-art features and pay only for the actual usage of these features. The other alternative would be to license these technologies on an annual basis for a higher fee and run them on your own server, where you continually need to maintain and upgrade the services.

The technologies to support these services are still being developed. XML and the **simple object access protocol (SOAP)** are two important technologies. SOAP is a method of describing and activating services across the Internet. Ultimately, to make it easier to find services on the Internet, companies will want to register with a directory. In many ways, Google is a primary Web service because it provides searches, and more importantly, delivers ads that generate money.

Network Services

A third category of Internet services consists of the network connections. As a consumer, you see a portion of this industry because you have to pay an Internet service provider (ISP) to connect to the Internet. Businesses also have to pay an ISP, but they have additional expenses that are provided by other companies. To create a Web site, you need to register the domain with a registrar paying an annual fee, purchase a security certificate for an annual fee, pay a hosting company to run your Web servers for a monthly fee, and pay someone to design, develop, and maintain your Web software—usually for a fixed fee plus maintenance costs. Several companies compete in these various businesses, and the industry brings in billions of dollars a year.

Internet Service Providers and Hosting

Providing Internet access to households and businesses is a big business. Think about how much you pay for monthly Internet service and multiply that number by several million. The business also has large economies of scale, both in providing services to users and providing facilities for businesses to host Web sites. Consequently, the industry has consolidated over the past decade. However, there is still a relatively intense battle for providing service for the final mile to individual households. Chapter 3 describes the various options and costs, but the

Technology Toolbox: Paying for Transactions

Problem: As a business, how do you get paid?

Tools: Many mechanisms have been proposed to handle payments, from cash to credit cards to cell phones.

Payment Method	Fixed Cost	Fixed Fee	Discount Fee	Fraud/Insure
Cash	Low except for security	$0.00	$0.00	Physical security
Check-physical	$20/month	$0.25	1.7%	Included
Check-electronic	$20/month	$0.25	2.5%	Included
Credit card-physical	$10/month Minimum $25	$0.25 - $0.50	1.6%	Covered: 0.08% fraud average
Credit card-electronic	$30 - $50/month Minimum $25	$0.25 - $0.50	2.6% - 4%	Not covered: 0.25% fraud average
Debit card	Setup/key pads	$0.35 - $.055	0% - 2%	None
PayPal	None	$0.30	2.2% - 2.9%	Covered for physical shipments

For decades, checks were the dominant payment mechanism in the United States. Only recently has it been possible to use electronic checks—essentially a direct debit to your checking account based on the routing numbers. Each method has potential advantages and drawbacks. As a businessperson, you might be tempted to accept as many methods of payment as possible, so you do not shut out potential customers. However, many of the methods have setup and fixed costs, so it can be expensive to accept everything.

Any payment method essentially has three main costs to the business: (1) fixed setup costs, (2) transaction costs as a fixed number and a percentage of the price, and (3) the expected loss from fraud or the cost of an insurance system. Often, there is an implicit cost to train employees in the proper procedures as well, which increases as you try to accept more variations of payments.

The transaction costs and risk are all paid by the seller. Merchant banks usually charge a monthly document or connection fee, and sometimes a one-time setup fee. A fixed cost per transaction is common, as well as a percentage of the sale. Customers often prefer credit cards, although in 2002, 15 percent of U.S. purchases were made with debit cards, and that number is increasing rapidly. Debit cards are useful to brick-and-mortar merchants because of the lower transaction costs and minimal risk. However, they are rarely accepted for online commerce because of the potential risk to consumer accounts. Checks and credit cards carry similar transaction costs today—when you factor in the insurance coverage for insufficient fund checks. One challenge with most of the payment mechanisms is that merchant banks usually require a monthly minimum fee charge. If your firm has few sales through the system, you will still have to pay $25 per month. For small companies just starting out in business, this fee can be expensive.

Quick Quiz:

1. Why have consumers rejected most electronic payment mechanisms?
2. What additional fees are charged for international transactions?
3. What happens if a customer refutes a charge?

primary choices are telephone (dial-up, DSL, or FiOS) and cable modem. Cell phone or mobile access is gaining in popularity but cannot deliver the same high-speed service of cable modems. Providing business connections generates even more revenue, with prices for a T1 line running about $400 a month. Most of the providers in this market are large and difficult to compete against. However, many small wireless firms have arisen to provide niche services in small markets. For instance, you could pay $400 a month for a T1 line and install a wireless modem and sell access to the Internet to your neighbors for a monthly fee. You can break even (not counting initial hardware costs), if you find 10 neighbors willing to pay $40 a month. Of course, you have to handle billing, marketing, and some legal and technical issues. So, you probably will not make much money, but a T1 line provides bi-directional speeds of 1.544 mbps, which can be useful if your neighbors want reliable speeds for video conferencing or other activities.

Web hosting is also a large industry. It has several major providers, led by those who have built huge data centers around the nation and world. The large ISPs, telephone companies, also provide hosting services because they have direct access to their networks. However, many of the large data centers cater to larger companies. So intermediaries have evolved who purchase space in the data centers and then resell services to smaller companies.

Design and Development

Compared to the other areas of Web infrastructure, design and development is highly fragmented with thousands of firms and millions of individuals working on applications and Web sites. The existing and potential demand is huge, both for individuals and for firms specializing in developing Web sites and applications. Chapters 12 and 13 discuss the various information technology careers and methods of organizing and managing the IT processes. For now, it is important to recognize that many Web-based careers exist, with a variety of skills ranging from artistic to programming, security, and management. It is relatively easy to establish a Web design firm and substantial demand exists for these services. Startup firms might need to focus on low-price jobs to gain experience and respect. Businesses can find several firms that will help with everything from art design, to programming, and custom marketing strategies.

Facilitators

Creating a commercial Web site requires a fair amount of effort and knowledge. Several companies advertise plans to put you on the Web for a low cost. These systems might work well for small businesses with a limited number of customers. However, few of them will scale up easily if your business suddenly grows. Creating and managing a Web site can be a complex process—made increasingly more difficult due to security issues. Consulting and specialist firms have arisen to help you understand these issues and design large, secure, complex Web sites.

Other facilitators have arisen to help with more mundane tasks. For example, most cities have small businesses that will help people sell items on eBay. In general, it is relatively easy to set up an account on eBay and sell various items. However, many people have only a few items to sell, do not want to take the time to learn the details of how eBay works, and are uncertain about their technical skills to handle the process. For a percentage of the revenue, facilitator firms will handle the complete process, including taking photographs, pricing the item, posting the information, validating the purchaser, and shipping the item.

Search Engines

Most people have used search engines to find information on the Internet. The searches are not always successful and tend to return a large number of sites unless the key words are specific and relatively unique. Nonetheless, search engines are an important method for potential customers to find your site.

One of your first objectives is to get your site listed and indexed on the major search engines. Each system uses a different process to search and categorize your site. All of the search engines have a Web page where you can register your Web site by entering the Internet address and a description of the purpose of the site. Eventually, your site will be added to the search engine list. Once your site is listed by one of the major services, the other search engines will also find it earlier.

Some companies offer to register your Web site with the search engines for a fee. While this process might be convenient, it is rarely necessary. The good search engines eventually find your site even if you do not register it at all. Some people claim to know tricks to make your page appear at the top of the search engine listings, known as **search engine optimization (SEO)**. Do not believe them. In some cases, the advice is harmful—search engine developers know most of the same tricks and will automatically punish Web sites that use the blatantly bad ideas. Read the Web site descriptions at the search sites for more useful advice. Basically, make sure your main page contains a precise description of the site's purpose. Include key words that consumers are likely to search for. Be as accurate as possible. Think like a customer and try searching for other sites. Look at the key words you used. Include them on your Web page. The problem with SEO firms is that the search engines continue to change their algorithms, and trying to optimize your site for one version can result in a huge drop when the search method changes. The ultimate goal of a search engine is to identify exactly what the user wants to see and provide just those pages. So your best objective should be to carefully define exactly what your site and pages contain so the search engine can match those pages to specific searches. The main focus should be on the page content and descriptions, meta tag keywords, and links from legitimate sites.

In some cases, there is a way to get your site listed higher up in the search engine results. Many of the sites accept advertising payments to give higher priority to your site. You will have to carefully evaluate the costs and benefits of this approach compared to other advertising strategies. Most search engines also rank sites based on their linkages from other Web sites. So, if you can get your site listed on established pages, with an accurate description, it can be found faster by the search engines and will often be listed higher on the results page. Remember that most people will not scroll through more than a couple of pages of search results to find your page.

Payment Mechanisms and Risk Mitigation in e-Commerce

How can customers pay for products and why do you need new payment mechanisms? Credit cards remain the most popular method of paying for items and services purchased on the Internet. In other transactions, debit cards have become more popular, but they are basically processed as credit cards for Internet transactions. Consumers like credit cards because they are comfortable with them and because banks have largely removed the risks to consumers. Chapter 6 describes the various transaction risks to the consumer, business, and government.

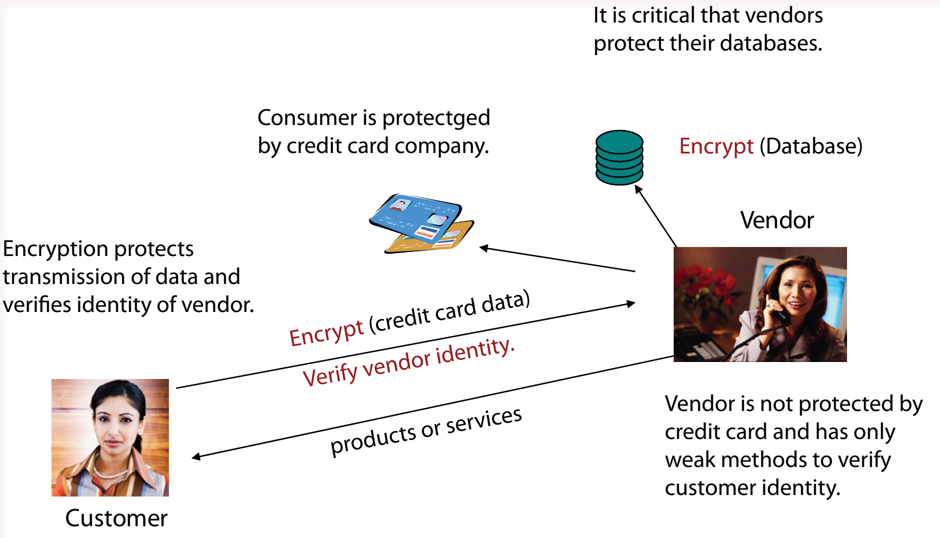


Figure 7.12

Risk mitigation in e-commerce. Encryption verifies the identity of the vendor and protects the data in transmission. Credit card companies accept risks for the consumers but not for the vendors. Huge vendor databases of credit card data are tempting targets and need to be protected by the vendor.

Payment Risks

The transaction risks in e-commerce are similar to those of traditional commerce, but with a couple of twists because of the network connection. The Internet is an open network where messages can be intercepted and transferred at will. Consequently, it is challenging for the merchant and customer to verify the other's identity. Similarly, both merchant and vendor need to be concerned about the transfer of money and digital products. Because these two issues stem from the same cause (the insecure network), they have both been solved through the use of strong encryption methods. These techniques are described in Chapter 5. They are commonplace on the Internet today, and consumers and vendors face minimal risk from the interception of data. Figure 7.12 shows that encryption can protect the transmission and storage of credit card data, but vendors still assume several risks because the only method they have to identify customers is by the credit card data. Some vendors attempt to reduce this risk by shipping products only to the home address corresponding to the customer's credit file.

The risks of nonpayment or nondelivery are more difficult to solve. They have been particularly challenging in an international environment where governmental jurisdiction and enforcement are not effectively defined. For the most part, consumers are still protected if they use a credit card to pay for a product. However, the consumer may still find it hard to prove that a product was not received. On the other hand, e-commerce businesses have virtually no protection from fraud. The credit card rules specifically exclude mail orders, telephone orders (MOTO), and Internet orders. The card companies will assist merchants in identifying invalid cards, but will not guarantee the transaction. This issue is important because the Gartner Group (*Computerworld* 8/11/2000) estimated that credit card fraud is

Credit card drawbacks
- High transaction costs.
- Not feasible for small payments.
- Do not protect the merchant.

Characteristics needed
- Low enough costs to support payments less than $1.
- Secure transmission.
- Authentication mechanism.
- Easy translation to traditional money.

Alternatives
- Mobile phone bill.
- Smart cards.
- Digital cash.

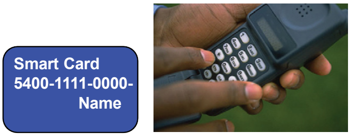


Figure 7.13

Payment mechanisms. Credit cards do not protect merchants and have high transaction costs, so they cannot be used for low-price items. Several systems have been created to provide the desired characteristics, but customers have not yet been willing to adopt them.

12 times higher for online merchants—with about 1.1 percent of all online transactions fraudulent.

Technically, it is relatively easy to use encryption to verify the identity of the merchant and the customer in any transaction. In fact, the common Web encryption system works because the merchant buys a digital certificate from an encryption company. Customers could obtain similar certificates or digital signatures, but they have little incentive to do so, since the credit card companies protect them. With today's encryption systems, transmission risks are relatively minor. Two far more serious risks are (1) theft of consumer data from the vendor's computer and (2) alteration of the purchase documents by either the merchant or the customer (repudiation).

The risk of theft is real and has happened to several vendors. The potential target is huge: thousands or millions of validated credit card numbers—all accessible via the Internet. The only effective solutions are for vendors either to keep the card numbers off-line or to encrypt them and bury the encryption key.

The second risk arises because digital orders are easy to alter. The solution is to create electronic orders that cannot be altered. Again, this solution requires encryption. In this case, the customer and the vendor both need a digital certificate. When both parties encrypt the order, it cannot be altered later.

Payment Mechanisms

Payment mechanisms must change along with the changes in transactions. Years ago, when purchases were made locally, currency was the primary method of settling transactions. Eventually, as banks stabilized and gained respect (and government guarantees), transactions were settled by checks. Business transactions (particularly internationally) are often settled with letters of credit from banks. In the United States, many payments have migrated to credit cards and debit cards.

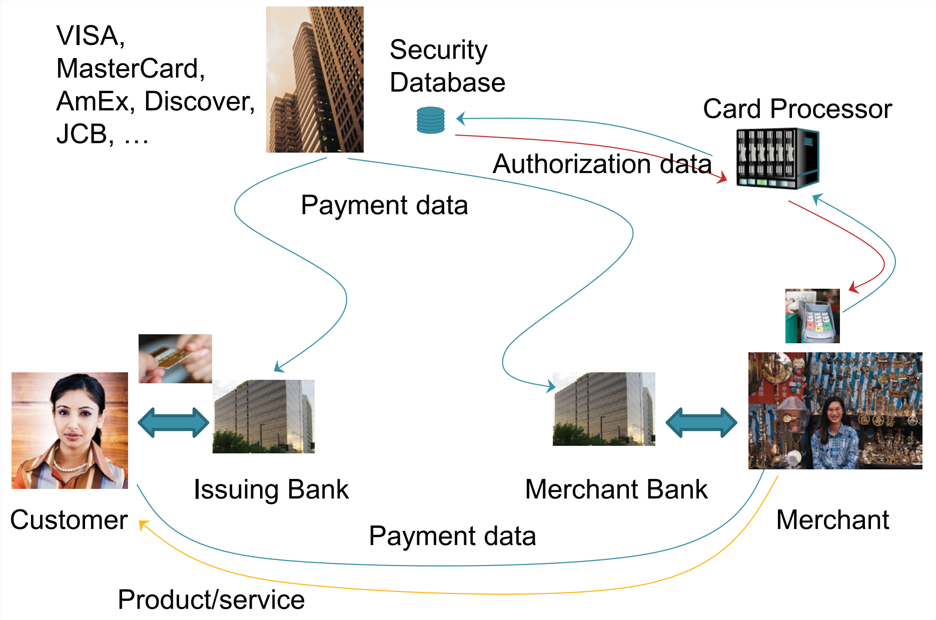


Figure 7.14

Credit card industry. Merchants can accept cards only if they are associated with a merchant bank and a card processor. Both of them charge fees. New, untrusted merchants, usually pay higher fees because the bank takes some of the risk.

From a consumer standpoint, credit cards are easy, available, provide short-term loans, and offer protection from fraud and errors. Figure 7.13 shows the drawbacks to credit cards and lists the characteristics desired from a new payment mechanism. From an e-commerce merchant perspective, credit cards offer only minimal support and are expensive. From the perspective of a mobile-commerce merchant, credit cards will be unacceptable because the transaction costs are too high to support small payments.

From a theoretical perspective, e-commerce payment mechanisms should be easy to create. In fact, dozens have been proposed or started in the past few years. None of them have garnered enough support to be successful. Some, like PayPal process payments, but most of those payments today are based on credit cards.

Figure 7.14 shows the main participants in a credit card transaction. The first important concept is that all of them charge for their services—and those fees are billed to the merchant. The second issue is to examine what happens if something goes wrong with a transaction. For instance, if a customer fails to pay bills, the issuing bank is stuck with the charges. Similarly, if a merchant skips town without shipping products, the merchant bank is on the hook. Both banks cover these risks by charging higher fees and limiting who they provide services to. So, small startup merchants might have problems finding a merchant bank and will probably have to pay higher fees.

Several companies have proposed alternative payment mechanisms, but most of them failed. PayPal (owned by eBay) has survived, but it is largely a credit card processing system now. Google and a few other Web sites also offer credit card

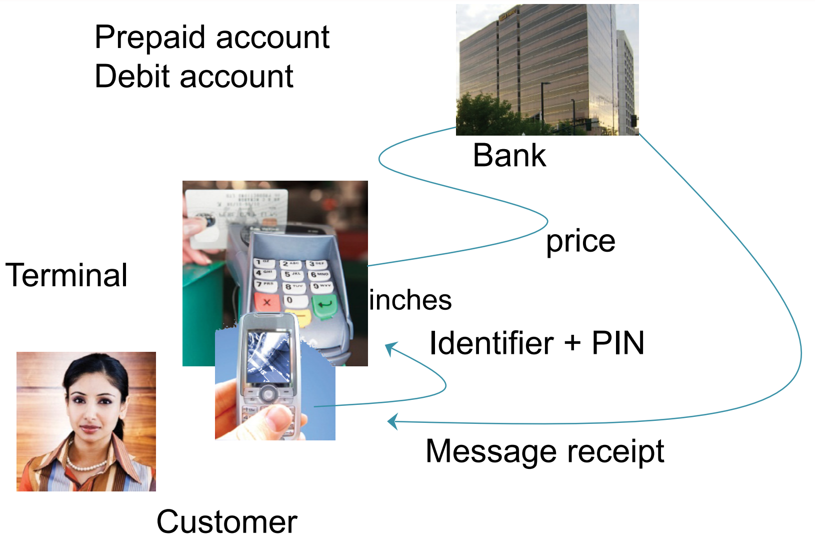


Figure 7.15

Near field communication payment. The cell phone contains a tag with an identifier that is read when placing it close to a terminal. Sometimes a PIN is added for security. The terminal subtracts the money from the consumer account which can be a prepaid account or a debit account.

processing. The main difference between these companies and traditional card processing is that the merchant never sees the credit card data. Customers enter the data through the PayPal or Google site and merchants receive an e-mail notifying them of the payment. By not handling the actual credit cards, the merchant faces fewer security issues, but pays higher transaction costs.

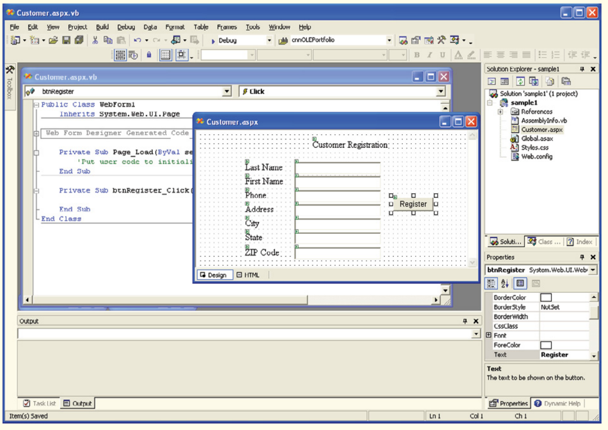
The main challenge with credit cards is the relatively high fees. The per-transaction costs make it difficult to accept credit cards for an amount less than $10. Mobile commerce offers one possibility for handling small transactions: put the cost on the customer's cell phone bill. Most phone bills already contain lists of small transactions, and the total monthly fee is high enough to pay using traditional mechanisms. As long as the vendor builds up enough credits with the phone company, the transaction costs on that side will be reasonable. Currently, the biggest potential drawback is the limited security. Phone numbers are easy to find, although a 4-digit PIN would improve security a little. Requiring physical access to the phone will provide more security, until the phone is lost or stolen.

For on-site transactions, mobile phone companies are beginning to offer **near field communication (NFC)** payment methods. NFC is similar to RFID in that it uses tags and readers that pick up data at very short range (a couple of inches). Essentially, cell phones have a chip (or perhaps a chip on a sticker) that contains encrypted identifiers. As shown in Figure 7.15, waving the phone next to a terminal transmits the ID and the terminal subtracts the payment amount from the consumer's account. This account could be a prepaid account or perhaps tied directly to a bank account similar to a debit card. In advanced systems, the terminal can send a message to the phone with the receipt and details of the transaction. Some systems require a PIN as well as the phone—which is useful if the phone is

Technology Toolbox: Choosing Web Server Technologies

Problem: How do your Web servers handle interaction and database tasks?

Tools: Web servers require special code engines to handle the interaction with users and the database. Three basic systems have evolved over time: Java (J2EE), PHP/PERL/PYTHON, and Microsoft .NET. Websites today are built using one of these three technologies. There are major differences in the underlying technologies and philosophies of the three approaches, and some developers treat them as "religious" issues—which is a way of saying that proponents of each often argue over the relative merits of their choice of technology. As a manager, why do you care about the three technologies? The main answer is that you will probably have to make a decision between them if you develop a website. All three have evolved considerably over the past few years and will continue to improve.



Of the three, Microsoft's .NET is the newest and has some features that do not yet exist in the other methods. It is also considerably faster and more efficient at processing code and connecting to databases. It is also the most expensive. Java is probably the second most powerful technology. It has the advantage of being a standard that is supported by many vendors. Systems developed using standard Java code can be transferred to run on Web servers built using a variety of hardware and operating systems. Not only is the server code inexpensive, but the hardware and Web server software are inexpensive. The other approaches use scripting languages that have diverse features. Websites built on these systems can be run on a variety of hardware and software platforms. In all three cases, you need to work closely with the hosting company to ensure that the proper hardware and software packages are installed.

Building interactive websites generally requires custom programming to tell the server how to handle the customer responses. Development environments exist for Java and .NET that help programmers write the code. Most applications are built as Web forms where the user enters the data. This data is then transferred to the server, and the code behind the form examines the values. Based on the responses, the data can be stored in a database, e-mailed to someone, or additional pages can be returned to the user.

The differences between the systems lie in the capabilities of the underlying code and the amount of effort it takes to write the code and connect to database systems. Increasingly, vendors are developing libraries of code for the three systems that prepackage common procedures. These packages enable developers to build new applications faster and with fewer errors

Quick Quiz:

1. Why would programmers become so attached to one system?
2. What are the advantages of choosing the most popular server technology?
3. What are the dominant costs of creating a Web site?

lost. The method is popular in Japan—particularly to pay for subways and trains. Apple and Google have both begun offering the chips in some phones. However, vendors need to upgrade their terminal systems and it is not clear yet whether the transaction fees will be low enough to justify adopting this payment method.

In summary, electronic payment mechanisms are still in their infancy. It could take years for a standard to evolve and be accepted by enough merchants and customers to be important. In the past, governments have borne the costs of creating and printing money. Today, most seem unwilling to become involved, and they have left the mechanisms to the private sector—which is more focused on developing a system that provides profits to the issuing authority, instead of developing a system that would be widely accepted.

Even for traditional businesses, **bill presentation and payment** mechanisms can make life easier and save money. Service businesses in particular can benefit because they tend to bill clients on a regular basis. The goal is to send all bills electronically and provide a simple method for clients to transfer funds to your account. If clients are large businesses, they may wish to use existing EDI or banking systems (wire transfer) to transfer money. Smaller companies with smaller payments will generally prefer the newer online payment systems because they have lower costs to the customers.

The electronic systems save time because the bills can be created automatically from the in-house billing system. They do not have to be printed or mailed. Customers can feed the data into their own accounts payable systems and create electronic payments with only a few review steps. The payment data, and any disputes, can be processed electronically and automated. Many systems work directly from checking accounts, effectively transferring an electronic check. As of 2007, the U.S. checking system supports completely digital copies of checking data, processing transactions within the existing system at relatively low transaction costs.

Advertising

How do firms get revenue from Web ads and how do customers find a site? Advertising has become an important source of revenue for Web sites. To understand and take advantage of advertising, you need to look at the process from three perspectives: (1) the advertiser, (2) the publisher Web site, and (3) the consumer or ad viewer. You probably have the most experience as the user, but do you recognize the three main types of ads in use today? As with other components of the Web, consolidation among companies has reduced the complexity of advertising. Today, you can deal with two or three companies to handle most of your advertising needs—both as a publisher and an advertiser. In fact, for 2010, the Interactive Advertising Bureau (IAB) statistics showed that the top ten Web advertising firms were responsible for over 70 percent of the total advertising revenue.

The three main types of Web ads are: (1) Small text links provided by Google or Microsoft that provide publishers with a small fee when users click on them; (2) Banner ads that contain images and flash video, where publishers are usually paid simply for displaying the ad to visitors; and (3) Independent links to third-party Web sites where the site pays the publisher based on the number of visitors generated.

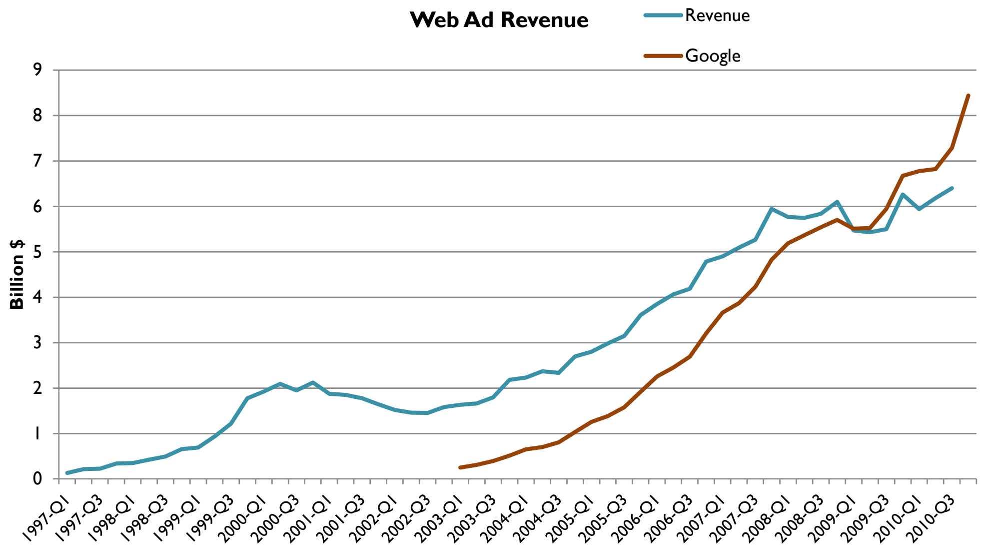


Figure 7.16

Web advertiser quarterly revenue. Revenue fell in 2001-2002 with the dot-com bust, but began to recover in 2003 as advertisers found new ways to attract customers. Sources: http://www.iab.net/resources/ad_revenue.asp and Google quarterly reports.

Traditional Media and Name Recognition

To a consumer, name recognition of a company is an important element of buying products over the Internet. Trust is particularly critical when the consumer is not dealing face-to-face with the merchant. Depending on your target customers, it might be necessary to build this name recognition through advertising in traditional media (television, radio, or newspapers). Some early start-ups chose the splashy, but expensive, method of buying television spots during the Super Bowl to reach a large audience. If you do use traditional advertising, make sure that your Web site name is easy to remember and easy to type. Avoid words that are commonly misspelled.

Web Advertisements

Web advertising offers some potential advantages over traditional advertising. Ads can be delivered to specific audiences and to some extent controlled so that people continually see new ads. Increasingly, Web ads deliver on their original promise of tracking responses by measuring the effectiveness based on the **click-through rate**, or the number of people who actually click on an ad and go to a site to get additional information. The original ad model matched the offline model by simply displaying banner ads on a page and waiting for people to click an ad.

Figure 7.16 shows the estimated total advertising revenue by year as reported by the IAB. Advertising fell from 200-2002 because of the dot-com crash and then accelerated when Google introduced keyword advertising. Google has since purchased several other advertising companies, including DoubleClick—one of the leading portals for banner advertising. Along the way, advertisers developed more

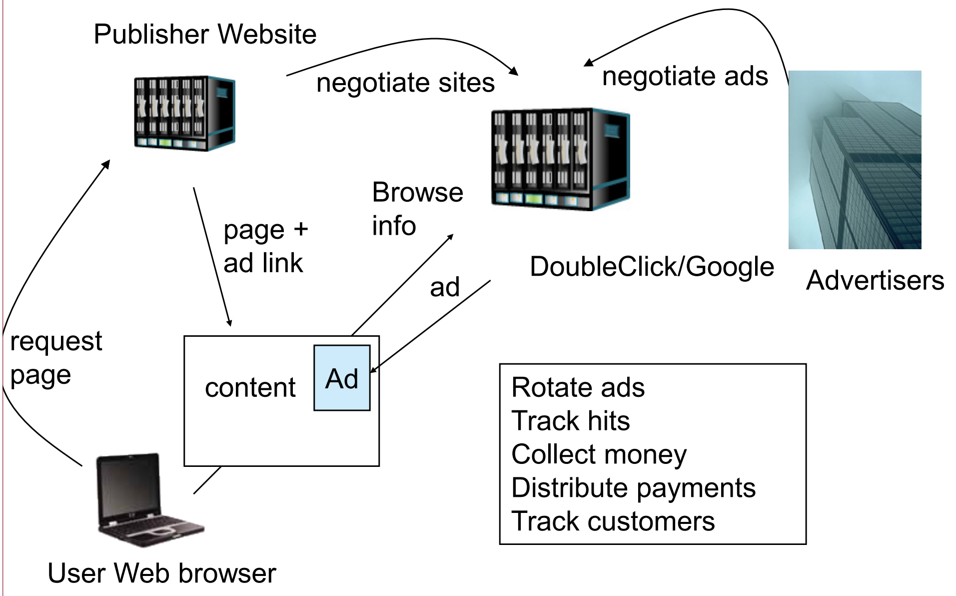


Figure 7.17

Advertising consolidator. DoubleClick provides advertising services by functioning as a central point for both advertisers and publishers. DoubleClick handles the details of delivering the correct ads, tracking impressions and collecting and distributing the money.

sophisticated ads using Flash and video. All of the parties have also increased the ability to track customers and monitor the performance of all online advertising. Still, the comparison to revenue earned by Google shows a strong correlation with the growth of online advertising. By 2008, Google was also generating some revenue from other sources, including hosting e-mail and Google docs, so Google's total revenue now exceeds the total online advertising revenue. Estimating total advertising spending is a challenge, but some reports suggest that online spending represents about 9-10 percent of the overall U.S. total. Based on changes in the industry, much of the online spending has come at the expense of advertising in newspapers and magazines.

Banner Advertising

If you want to advertise on a site, how do you get started? If you have a popular Web site, where do you find advertisers? Like the traditional world of print, radio, and television advertising, the daily issues of handling the ads, monitoring placements, finding clients, and billing can be time consuming and expensive. Most sites choose a third party to perform these tasks, and DoubleClick is by far the largest such company. Of course, DoubleClick takes a portion of the ad revenue for its services. Figure 7.17 shows the intermediary role played by DoubleClick. The third party also simplifies the process for advertisers, since it would be difficult for a company to contract with hundreds of sites to place ads. In 2007, Google purchased DoubleClick from a private equity firm, to consolidate its role in the advertising market, but it still operates under the original name and Web site. In

Want viewers to see the ad.
Want viewers to click through to the main site.
Want to collect contact information from viewers.
Need to match site demographics to target audience.
Monitor response rates.
Cost.

Figure 7.18

Web advertiser perspective. Advertisers want the biggest target audience possible. They need demographics about the Web site visitors, and they monitor response rates.

2004, DoubleClick earned about $300 million in revenue, so despite its position, it receives only a small percentage of the total advertising spending. Although it is convenient for advertisers and publishers to deal with a single central intermediary, it is relatively easy for users to block ads from the central server. Check the Internet for information on how to add the DoubleClick sites to your hosts file and your computer will stop receiving any information from them.

An interesting twist on banner ads is that video games are now beginning to place ads. Games that connect online can download new ads. Generally, the ads are embedded within the game, such as billboards on car-driving games. But at least one pizza company added a link to a game so that players can click an icon within the game and order a pizza for delivery.

Advertiser and Publisher Perspectives

In the world of traditional banner ads, similar to the offline world, advertisers will place ads based on the demographic characteristics of the potential viewers. Figure 7.18 summarizes the perspective of advertisers—the ones who pay for the ads. They generally want the ads to be seen and to generate click-through responses. There is some argument that click-through rates are not an effective measure of advertising. Possibly the effect of an ad is to build an image or a brand name. Consumers might not need to purchase something immediately, but they might remember the ads later and use them to accept the validity of the company.

Increasingly, advertisers want to establish a relationship with the potential customers. Consequently, audience size and demographics are important to advertisers. In particular, advertisers are finding the most success in targeting specific sites. For instance, automobile manufacturers find it worthwhile to advertise on sites dedicated to automotive topics (such as vehix.com, Edmunds, and autobytel.com).

Many Web site publishers would like to get a share of the advertising revenue, but keep in mind that according to the private Internet advertising bureau (IAB), about 75 percent of online ad revenue goes to the top 10 Web site publishers. So, there is not much left for “your” share. The first catch is that you need a substantial volume of visitors to get anyone to consider your site. Probably at least 25,000 unique visitors a month, and 1 million would be a more likely minimum—since advertisers prefer larger audiences. Figure 7.19 shows some of the key points from a publisher’s perspective.

One of the most difficult issues is obtaining the demographic data. You need some mechanism to identify your Internet users and to obtain some personal data

Income
- Cost per thousand viewings ($1 - $50)
- Need volume (25,000 or 1,000,000 per month)
- Need demographics

Tasks
- Ad rotation software
- Tracking and monitoring
- Ad sales staff
- Billing
- Third Party: DoubleClick

Figure 7.19

Web publisher perspective. There is money being spent on advertising, but your rates depend on volume and the ability to provide detailed demographic data. The daily tasks of sales and providing the ads are often handled by a third party like DoubleClick.

from them. Of course, this data raises many privacy questions. Most sites find that they have to reward customers in some fashion to get them to provide personal demographic data, but it is often amazing how little is required to get customers to respond. Common tactics include random drawings for prizes or free trinkets. The other approach today is to have focused Web sites and then match the demographics against the existing public data. For example, antique car sites attract a particular demographic, while baby sites attract another group.

Google Keyword Ads

In 2002, Google changed the online advertising world by introducing click-through ads tied to searches. Look again at Figure 7.16 and it is clear that the entire increase in online advertising since 2002 has been due to Google ads. The basic concept is straightforward, but to use the system effectively, advertisers must make some complex decisions. Advertisers choose keywords. When a user enters that keyword in a Web search, Google displays an ad from a company that purchased that keyword. Users win because the ads are likely to match what they are searching for. Advertisers win because users are more likely to respond to the ad—and advertisers pay only when a user clicks on the ad.

One twist is that prices for keywords are not fixed. Instead, advertisers purchase keywords based on an auction process. The company that bids the highest price for a specific keyword gets listed higher in search results. Since thousands or millions of people might search for a keyword, advertisers need to control expenses by specifying a maximum budget, such as a maximum daily amount. When the budget is spent, your ads will no longer appear. So the highest-price bid can vary throughout the day, week, or month depending on the bids and budgets of competitors. Advertisers must choose keywords, the bid price, and the budget amount.

As shown in Figure 7.20, Google provides support for selecting keywords and estimating bid prices and daily budgets. In particular, Google shows the average number of daily searches for the keywords you select so you get some idea of the popularity of each word. Google also shows the current average prices being paid by your competitors for each keyword and the approximate position your ad will get. You can use this information to set a daily budget. Be careful—some words

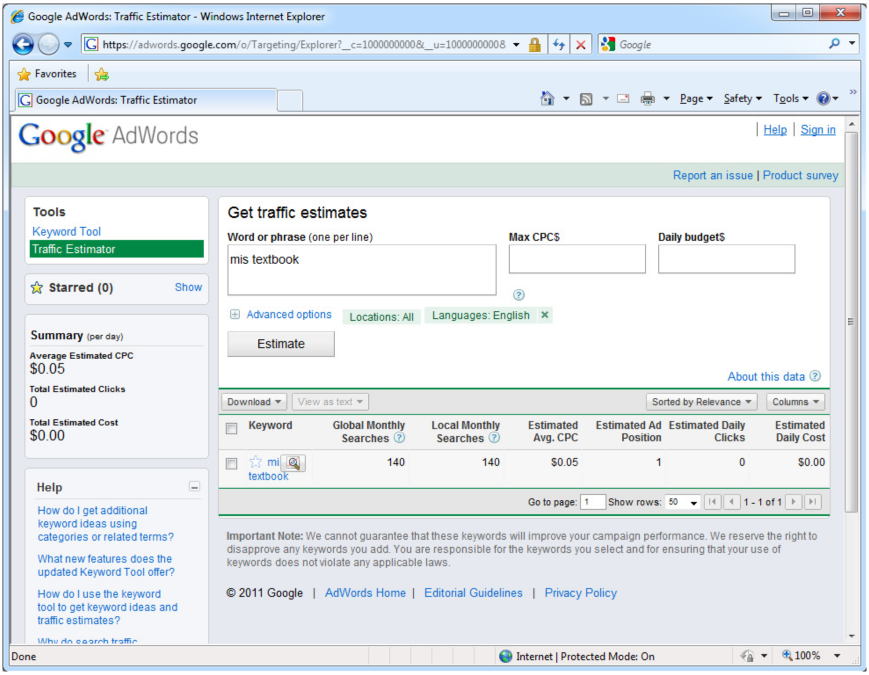


Figure 7.20

Estimating budgets for Google AdWords. Google provides estimates on the number of daily searches for each keyword you select. It also looks at the average bid price for those keyword ads and estimates a daily cost and ad position.

can be expensive. Paying a higher price will put your ad near the top of the list, but it will quickly blow through your budget. Pricing your ad too low means that it will not make the first results page. Increasingly, people will never look beyond the first page of results or ads. On the other hand, if customers never see your ad, they will not click on it and you will not have to pay anything to Google. So, perhaps there is a strategy of bidding low and waiting for all of the other budgets to run out. Ultimately, results also depend on the number of competitors. In the end, you have to experiment with different words at different times to see which customers actually click your ad and how many then complete a purchase. Oh, you also have to write the ad—but it is easy to look at the format of other ads to see what features are attractive and which ones are not.

Google AdSense

Another Google twist was the introduction of AdSense—which is designed for publishers of other Web sites. Basically, anyone can place Google ads on their Web pages. The process works the same way as AdWords, but Google matches the keywords to specific sites (instead of waiting for a search). Visitors to your site see ads that are placed by Google. When visitors click an ad, the advertiser is charged through Google and Google shares a portion of the revenue with your publishing Web site.

One of the strengths of the Google approach is that it is relatively easy for both advertisers and publishers to join the program. And both can experiment without

Reality Bytes: Sales Tax Revenue Declines

Citizens often want governments to provide services such as parks, education, roads, police, and so on. Many of them do not realize how cities and counties fund those operations. In most states, property taxes are the primary source of revenue—followed closely by sales taxes. The Census Bureau reports in 2008 that on average 23 percent of U.S. state and local taxes come from sales taxes. The recession of 2008 resulted in declines in purchases—hence a reduction in sales tax revenue. But, the National League of Cities reported that municipal sales tax revenue declined in six of the ten years from 2005-2010. Part of the problem is that cities and companies overbuilt the number of malls. The amount of retail store space increased by 126 percent from 1970-2010 while population increased only 52 percent. But, city leaders are concerned that online sales ultimately are a problem because they will reduce sales tax revenue collected through traditional stores.

Adapted from Miguel Bustillo and Kris Hudson, "Faded Malls Leave Cities in the Lurch," *The Wall Street Journal*, June 8, 2011.

long term contracts and can begin with low numbers and small budgets. In other words, it is easy to experiment and tweak your involvement until you find a combination that works. Even small advertisers and Web sites with a small number of viewers are welcome. In many ways, Google democratized the online advertising world. Almost anyone can now advertise or receive money from ads even with low traffic volumes.

Click Fraud

One potential problem with Google's approach is the opportunity for click fraud. In theory, you could enter a search at Google for your chosen keyword; then repeatedly click on your competitor's ad—driving up its costs and forcing it off the list when the budget is reached. Google claims to have software in place to recognize these attempts, and claims that fraud rates are relatively low. For example, ad clicks from the same IP address in the same day are supposed to be charged only one time. Fraudsters have to be a little more sophisticated than sitting at their desk clicking away. And most people are probably relatively honest and would avoid such behavior. Nonetheless, you need to monitor your usage data and click through rates to watch for potential problems.

Privacy

Privacy is the important flip side of advertising. The more serious privacy problems that have arisen were due to issues with advertising. The problem is the trade-off faced by advertisers. Companies want to target ads as closely as possible to people who are likely to care about and purchase the product. Hence, advertisers want to know a considerable amount of information about current customers and viewers of various Web sites. Yet collecting this data creates a loss of privacy for the customers.

DoubleClick instigated one of the broader privacy problems. By routing so many ads through its servers, DoubleClick is able to track the Web pages visited by each of millions of Web browsers. At one point, DoubleClick wanted to sell this information along with demographic data on the individual consumers.

Most consumers are not happy when a company tracks the sites they visit without informing them of the process. The basic premise of tracking demographic and customer data is that, by knowing more about the customer, it is easier to provide specific ads and data that might appeal to the customer and, in essence, fewer "junk" ads the viewer does not want.

Most advertising sites, including DoubleClick, use third-party cookies to track sites visited by as many people as possible. When you visit a site that contains a DoubleClick ad, DoubleClick inserts a cookie on your computer that records the time, Web site, and ad displayed. Any other site that uses DoubleClick returns that tracking cookie. Because thousands of sites use DoubleClick, the company can generate an extensive summary of your online activity. In 2010, the Wall Street Journal ran an extensive series of articles on the area of Web advertising and privacy. Consumers can take some actions to protect their privacy. For example, most browsers have privacy settings to block third-party cookies. These settings have to be made manually. Browsers also have more advanced "private" modes which block almost any data and cookies, but allegedly in response to advertiser complaints, the developers (particularly Microsoft and Google) have made it somewhat difficult to enter that special mode. In 2011, Microsoft announced that it would support an opt-out privacy filter that would give people some ability to prevent Web sites from tracking any information about them. It remains to be seen if these tools will be implemented or if they will be useful.

Developing and Hosting Web Sites

How do you create an EC Web site? Once you have decided that you want to participate in EC, you need to figure out how to create the site and get it hosted. In part because of the expense of maintaining a high-speed Internet connection, several companies have been created to provide alternative Web-hosting options. These hosting companies already have high-speed Internet connections, Web servers, databases, and management staff. They provide a variety of leasing options to host your site. One of the most important decisions to make regarding the Internet is where to locate the Web files. A variety of choices exists, and each method has different advantages, costs, and drawbacks. The choice of Web-hosting method depends on several characteristics of your business. Companies will often start with one option and move to other selections as they expand—particularly small firms or start-ups.

Today, companies rarely host their own Web sites. Several huge companies provide comprehensive capabilities with servers located around the world. Even if you want total control over your own servers, several companies provide co-location services, and with high-speed Internet connections, it no longer matters where servers are physically located. Even large companies that have the expertise to run servers typically make use of these large server farms. Virtual machine technology has made it even easier to use hardware maintained by other companies. The virtual servers can be configured and moved to any physical hardware. Even if you want a retail Web page to display the current inventory level (to indicate if an item is in stock), the Web server can connect to your internal databases across the Internet. Still, there are times when companies will want to run their own servers. The bigger question is when you can use existing software and when it is necessary to create custom software to run on the servers.

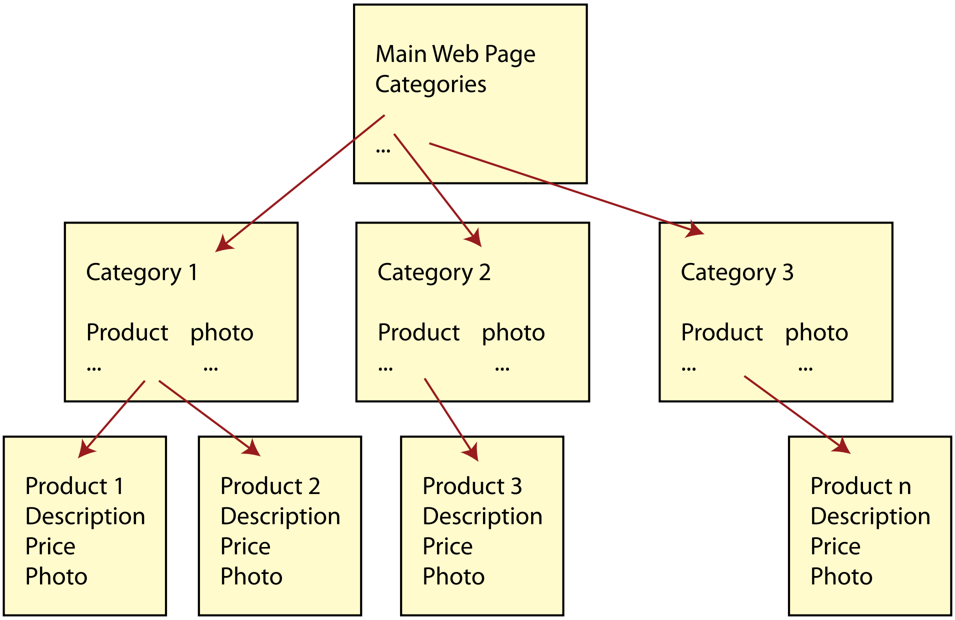


Figure 7.21

Retail website with simple pages. Each product will generally be on a separate page, but each page must be created individually and linked by hand.

Simple Static HTML

The most basic Web site consists of simple HTML pages—text and some images. These pages are generally fast to load, require minimal support from the server, and are relatively easy and inexpensive to host. For example, many Web providers offer free Web space. Most developers try to hold Web pages down to about 50KB per page, including graphics. The goal is to keep download times to an acceptable level even for slow connections. These basic Web sites cannot interact with the viewer. For example, you cannot accept form data or process credit cards. Similarly, the Web pages cannot interact with your internal databases. Generally, a single set of pages is made available to everyone, with little or no customization for individual users.

Although these relatively simple pages are easy to create, it is difficult to change them and keep them up to date. All changes must be made individually, and the developer must keep track of the details.

Consider the steps involved in creating a retail Web site with **static HTML** pages. You write a page that describes each product, including price and photo. You create a style for the site, adding fonts and colors. You can link the pages, probably using some type of index or a start page that lists major categories. With free hosting, it is rare to have a personalized search engine, so customers will need an easy method to find the products you are selling. Figure 7.21 shows the resulting hierarchical structure that you will have to follow. Each product will ultimately be displayed on a separate page. Each of these pages must be created individually, and links created by hand. To change any content, such as prices or

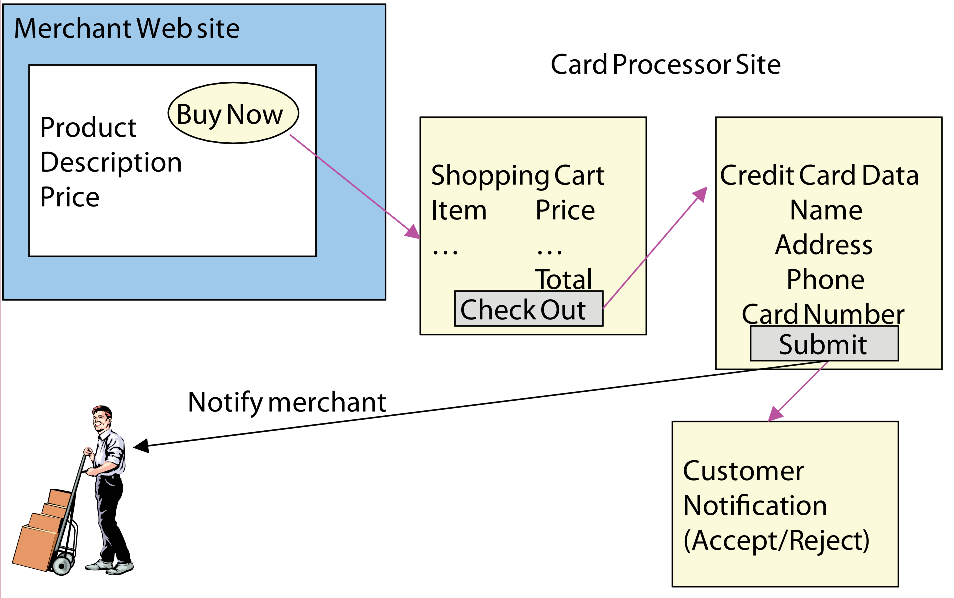


Figure 7.22

Order processing with static pages using a third-party processor. Clicking a link brings the customer to the card processor to enter card data and make the purchase.

descriptions, you must go to the desired page and make the change. This method may work for a small number of products, but as the number of products increases, it will become difficult for the developer to keep content and links up to date, and virtually impossible for users to find anything.

The other challenge with this Web structure is that the static Web server will not collect customer data, and because it cannot process form data, it is challenging to process a sale. One method is to use e-mail, where the customer enters product choices into a message that is e-mailed to your order-processing department.

The "Buy Now" or "Buy Me" button is one of the easiest methods to accept online payments. Several companies, such as goemerchant and Google, offer these checkout services. You set up a merchant account with one of these services and place a couple of lines of HTML text on your page. When users click the displayed "Buy Now" button, the item is added to a shopping cart that is maintained by the service provider. As shown in Figure 7.22, to purchase the items, the user is taken to the checkout form run by the service provider. All credit card and payment data is handled by the provider—the merchant never sees the customer's financial information. This process makes it easier for the customer to trust the merchant, and the merchant does not have to handle the security problems and costs associated with collecting and storing credit card data. Because all of the interaction and processing is handled by the service site, the merchant site can run as simple HTML pages. Of course, this convenience carries a price—the service provider collects a fixed fee per transaction and a percentage of the sales revenue. However, if you decided to handle your credit card processing by yourself, you would still have to pay the credit card company and a card processor firm. So the net cost to using Google is relatively low. Plus, you can get a service that does

Uncertain prices
Can set reserve price
Good for unique items
Efficiency depends on
  Full information
  Adequate number of participants

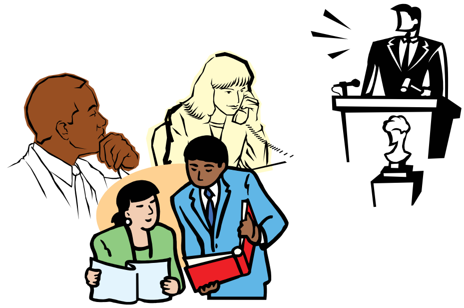


Figure 7.23

Auctions. Good for unique items where you do not know what price to set. Economic efficiency depends on the number of participants and full information.

not charge fixed monthly fees, enabling you to start small and pay only when you actually have sales. However, these services tend to provide less vendor protection than you get by using a credit-card processor. Many seller complaints against PayPal are listed on various Web sites with claims that PayPal does not support vendors. It seems to be a risky PayPal strategy, because vendors are the ones who pay the fees and choose the provider.

The main drawback to this method is the difficulty in updating the data, and the related challenge for the customer in finding specific products. Because the pages are static, you have to edit each page separately if you want to change data. And it is difficult to add search and filter conditions to help customers find specific products. Static pages work when you have a limited number of products that tend to remain the same and do not require customization.

Web Auctions

Some companies are interested in selling only a few individual items. If you want to experiment with the Internet, have a few unique items, or need to clear out a couple of items, it usually does not pay to set up a separate Web site—primarily because it would be hard to attract customers on a part-time basis. EBay.com is the best-known general **auction** site. The system operates similarly to newspaper classified advertising, but interactively enables potential buyers to bid on items. As highlighted in Figure 7.23, anyone can buy or sell products. The Web site lists the products and tracks the bids. At the end of the bidding period, the seller contacts the high bid and arranges shipment and payment.

One of the major difficulties with individual sales is authentication and ensuring that the transaction is handled properly. The buyer runs the risk that the seller is dishonest. If the seller ships the item before receiving payment, the buyer may never pay up. Most sellers are unwilling to accept this risk, so they generally require the buyer to send payment before the item is shipped. However, the buyer runs the risk of fraud. In 2000, eBay recognized the importance of this problem and added the ability for sellers to accept credit cards from any buyer (called Billpoint).

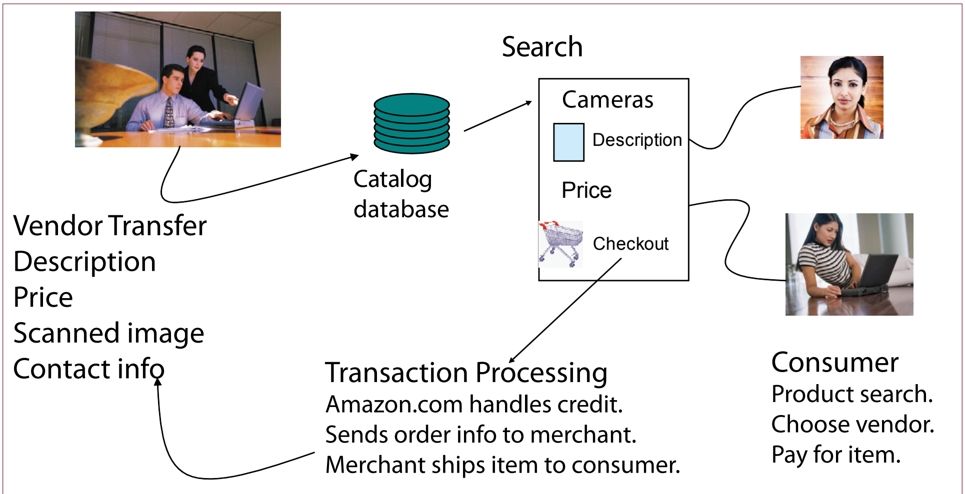


Figure 7.24

Amazon.com WebStore. Vendors list individual items. Consumers see WebStore as the store and search for a product. Amazon.com can process the credit card-based purchase, and the vendor ships the product to the consumer. Vendors pay fees for listing items, selling them, and using the credit card processing.

Several layers of pricing exist at auction sites. Generally, the seller must pay a fee to list the item and a second fee once it sells. If the item does not sell, the seller pays the first fee. The fee amounts depend on the value of the item being sold and on the options you choose. Read the fee schedules closely. For an average, figure $1 to list an item and about 3.5 percent of the value when it is sold. If you choose the credit-card billing option, the seller will generally pay another 3.5 percent of the selling price. As eBay has grown in size, the other auction sites (such as Yahoo) have left the industry. Economic theory states that relying on a single provider of auctions might affect the charges because of a lack of competition. However, a single site makes it easier for buyers and sellers to find each other.

Amazon WebStore

Amazon.com was one of the early e-commerce sites to enable small merchants to start Internet sales. As shown in Figure 7.24, the system (Amazon WebStore which used to be called MarketPlace) enables merchants to sell items by setting a fixed price. Listing items for sale is similar to the auction process. The seller pays a fee for listing the item and a fee based on the selling price when the item is sold. The fees change over time, but are loosely $1 per item plus 6 to 15 percent of the item's value. Amazon also imposes some limits on the prices you can charge for various items. The company provides a bulk loading program to transfer all of the product descriptions and prices.

Amazon is essentially a Web mall that supports a number of sellers. Since the products show up in a regular search at Amazon, many customers do not know they are dealing with a third-party supplier. Consequently, although the costs are relatively, high, the sellers gain instant credibility from the Amazon name. Other companies offer merchant mall services, but few have the name recognition and customer base provided by Amazon. Amazon also provides a system for vendors to create their own store sites.

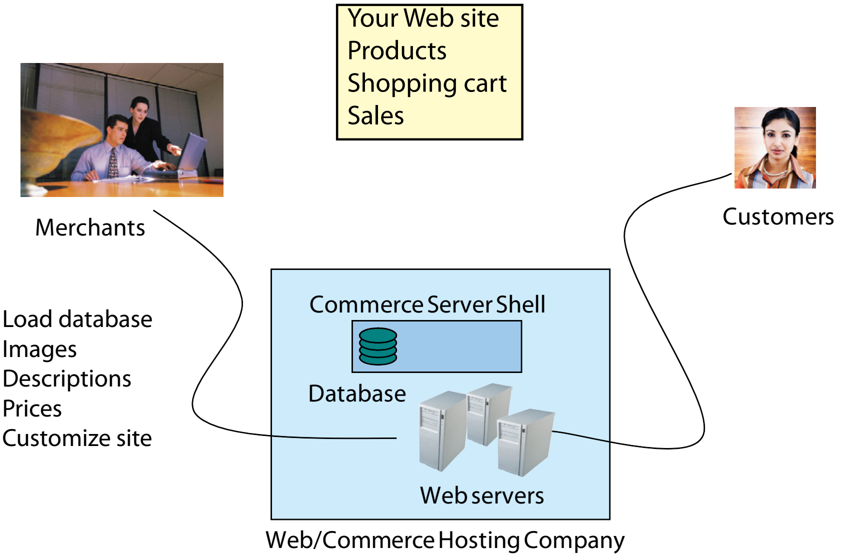


Figure 7.25

Web commerce servers. The Web hosting company provides the servers, Internet connection, and commerce software that processes transactions. The merchant loads the database with product descriptions, images, and prices. The commerce software provides a typical retail experience.

Auction versus WebStore

If you wish to sell a small to medium number of items, then auctions and Amazon are a good option. The transaction and shipping costs tend to rule out low-priced items. On the other hand, buyers are somewhat leery of high-priced items from unknown sellers. For example, most people might consider buying a rare coin from a dealer but would be more reluctant to deal with an unknown independent seller.

If you have a small number of intermediate-priced items to sell, should you choose an auction site or Amazon? Auctions are particularly useful for unique items or items where you are uncertain of the value. The WebStore system has a good search engine and works well for small retailers who wish to maintain a continued presence on the Web. Auctions present a slight uncertainty in the final price. However, economic theory observes that an auction that is based on free information, and attracts all the relevant participants, will result in the highest price. One computer manufacturer that traditionally sold only through distributor channels tested this theory in 1999 by offering a limited number of machines at an auction site. All of them sold for higher prices than could have been obtained through traditional outlets. Keep in mind that if you have several products, you can always try multiple outlets and test the response.

Web Commerce Servers

Transactions on Web sites are often handled by Web commerce servers. These software programs provide all of the features needed to run a commercial Web site. As shown in Figure 7.25, the site can be run by a specialty hosting company, or you can run it on your own servers. The software is used by companies like Amazon to host multiple sites. You can also lease it from specialty hosting firms just to provide services for your company. The capabilities of the site depend on the features available in the software. As a vendor, you should examine the features of different site products to see which ones you need. Software systems are available from several companies to run on your own servers or as a hosted service. Dot Net Nuke is a popular open-source system for Windows-based servers and Joomla is sometimes used on Linux-based servers.

The Web hosting company provides a server, a connection to the Internet, an account for the hosting software, and credit-card processing. The Web **commerce server** hosting software provides displays of your products, the ability to customize your store's displays, a search engine for your products, and the ability to process transactions securely. Some of the hosting software packages offer detailed customization options, while others are more restrictive; but all of them provide the basic elements you need to create and run a retail Web site. The Web hosting company generally charges the retailer a setup fee, a fixed monthly fee, and a transaction fee—particularly for processing credit cards. The fees are highly variable and each company bases them on different parameters (such as number of products versus number of transactions). The main strength of the Web commerce software is that you load product information into a database so it is easy to update and easy for customers to search. The software contains all of the code to build a relatively sophisticated Web site—you simply customize it with your own designs. Today, you can build many elements of a commerce server using components produced by the open source community.

Content Management Systems

If you have a small business with a Web site that sells only a few items, it is relatively easy to create and manage the Web site. On the other hand, you might have hundreds of products and need to change descriptions, photos, or prices on a regular basis. Or you might have thousands of pages of content that need to be updated. For example, a service organization might include descriptions of services or analysis of recent events. Keeping pages up to date can require the participation of dozens or hundreds of workers to create and edit the content.

A **catalog management system** is designed to help you maintain a database of products for sale on Web sites. You enter product descriptions and prices on a local system and it updates the Web site catalog. The system has to recognize and know how to communicate with your commerce server software. The main strength of the catalog management system is that it focuses on the products and provides tools to group them into categories and change prices. It can then automate the Web server updates.

Web sites that focus on text pages instead of products are often more complicated. The pages can be written by hundreds of different employees. You want all of the pages to follow a standard style and to fit into your Web site's structure and search system. You cannot let hundreds of employees edit the Web site directly—it will be next to impossible to maintain consistency and security. A **content management system** is designed to make it easy for nonprogrammers to update content, maintain a consistent style, and keep track of changes to a Web site. The systems generally allow workers to create content using traditional editors such as Microsoft Word, and then convert the text into HTML and store it in the appropriate pages. They also track the revisions, so you know who changed each page and

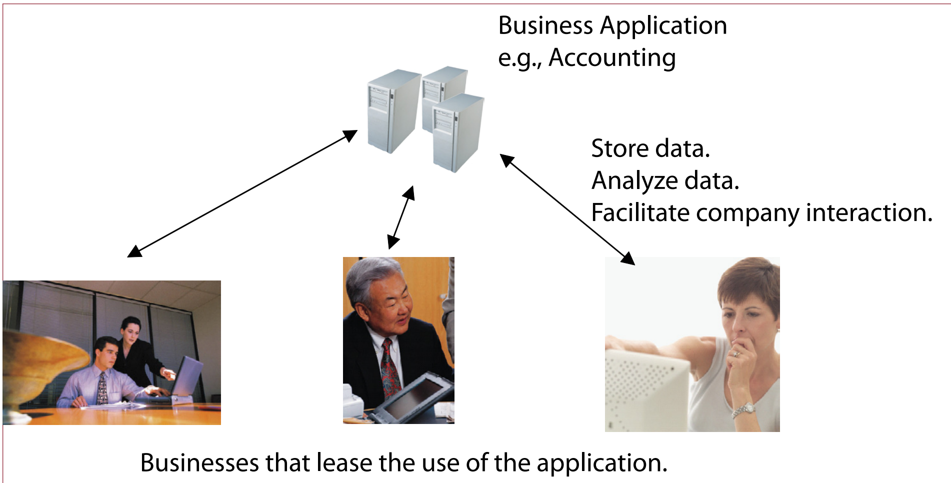


Figure 7.26

Application service provider. The Web server runs an application that holds data for other businesses. The data may be exclusive to one business (e.g., accounting); it may be used to interact with other businesses (e.g., supplier auction site); or businesses may interact with consumers (e.g., real estate).

when it was modified. Most of the systems also maintain version control so you can switch back to an earlier version of a page if something goes wrong.

Application Service Providers

An **application service provider (ASP)** is a Web-based business that provides a specific service to other businesses. The service is very specific, and might or might not involve interactions with customers. For example, as shown in Figure 7.26, one company provides online accounting services for small businesses. For a monthly fee, you can enter all of your transaction data and generate standard reports. Other ASPs act as intermediaries in providing services. For instance, a few major companies provide Web-based real estate listing services. Other companies provide online reservations services for service businesses.

If you can find an ASP that provides the services you need, it will generally be easier and cheaper to use the services of the ASP than to create your own Web site. Competition should eventually give you greater choices in price and quality. Even if an ASP does not exist for the service you wish to provide, it might be possible to convince a firm to adapt their products or create a new service.

The other way to look at ASPs is to find your own application service that you can provide to other organizations. It takes time to create the application because it is almost always custom programming. But, once the application is running, it generates money on a regular basis. And you might be able to collect advertising revenue from the site—which also rolls in every day.

Web Hosting Summary

As shown in Figure 7.27, once you know the type of e-commerce site you wish to run, you need to select a hosting option. Today, most companies outsource their Web sites to specialty data-center companies that have direct high-speed connec-

Business Situation	Hosting Options
Small business with a few basic items.	Static HTML with a Buy Now button.
Unique items of uncertain value.	eBay auction.
Many items but minimal configuration issues.	Web commerce server hosted by third party.
Many unique items and merchant identity is not critical.	Amazon WebStore
Unique service.	Custom programming, probably run on a hosted server.
Custom application with tight linkages to in-house applications and databases.	Custom programming running on your own servers.

Figure 7.27

Web hosting options. Today, most companies host their Web applications on the servers of specialty companies. Your job is to match the services you need for your business.

tions to the Internet. But, you can choose from thousands of companies with many different options. You need to begin the process by identifying the primary features that you need. For example, if you need your own brand identity, you will want your own URL, so Amazon WebStore might not be the best solution. If you need custom programming, you will have to find a hosting company that provides support for the languages and databases you need. If you need Web commerce software, you will want to test the catalog management system to ensure it is easy to use and compatible with your existing systems.

Web hosting companies typically charge fees based on the disk space used by your site and by the monthly data transfers. The monthly data transfers become one of the critical issues and tend to affect the price. If your site contains lots of video and large photos, or if you expect millions of visitors, you will need to look at hosting packages that provide the ability to transfer huge amounts of data each month. The monthly data transfer number represents the cost of the bandwidth that you are using. It is a difficult number to estimate for startup firms. You can try to estimate it based on the expected number of visitors, the average number of pages viewed, and the size of the page in bytes. But the expected number of visitors can be hard to estimate. Once the site has been operating for a few months, you can get a better idea of the data rates. Until your site gets mentioned on a national radio or TV show and the number of visitors skyrockets.

Web hosting companies provide several levels of service—with increasing prices for each type of service. The simplest hosting consists of basic HTML pages, with no database connectivity and limited programming. You might or might not get your own name as a Web address; but you can probably find this level of service at almost no cost. You can add more features to basic sites to add more e-commerce options. For example, database connectivity makes it easier to store product details. Programming support is useful if you need to customize the Web site. Preprogrammed shopping carts and security certificates are useful if you handle payments yourself. Web commerce software simplifies the tasks of handling product sales. Most companies provide these services on a shared server—where

Figure 7.28

M-commerce tools. As cell phones and tablet computers converge, people can connect to any business every place they go.

hundreds or even thousands of other company sites are hosted on the same physical server that is owned and managed by the hosting company. Another option is **co-location**, where you own the server hardware and install the software and manage the system and security. Essentially, you just rent space and a high-speed Internet connection from the hosting company. This option is useful if you are concerned about security or interference from other Web sites, and have the personnel to manage the server and security issues.

Running your own Web server is a challenging task. The software and servers are relatively easy to deal with. Security and monitoring are considerably more complex. Plus, it is expensive to install high-speed Internet connections to your premises. But, sometimes you have no choice and need the total control over your applications. Before you take this step, be sure to hire experienced security experts. And keep in mind that even large firms like Yahoo host their servers at specialty sites. Google is an exception—in addition to running its own Internet connections, the company custom-builds its own servers.

Mobile Commerce

How do portable Internet connections (mobile phones) provide new ways to sell things? In many ways, mobile commerce may not be much different from the existing Internet. As shown in Figure 7.28, users have cell phones and tablets with wireless connections to the Internet. However, for the near future, these appliances will have small, even tiny, screens. With 3G wireless networks, led by Verizon, the data transmission speeds have improved but are still relatively slow. From a technical standpoint, companies will have to rebuild their Web sites to support these devices. Each screen of data will have to be carefully designed, most graphics will have to be downsized, and the page navigation will need to be simplified. Because the keyboards are hard to use, the Web sites will have to reduce the amount of data to be entered. The most recent 4G services are relatively fast (particularly LTE offered by Verizon) as long as congestion stays low. Higher speeds lead to new possibilities, including video; which might open more opportunities for sales and marketing.

The real benefit of wireless connections is that they create new opportunities. If people are connected everywhere (or at least in the major cities), a vast amount of information becomes available at any time. Stores could instantly provide detailed product information to customer phones. For B2B sales, a salesperson could instantly retrieve data on competitor products, build charts, and transfer the presentation to the customer's system. Payments could be handled with wireless transfers of secure code, digital signatures, or even biometric data.

M-commerce will have an impact even on businesses that choose to stay with traditional sales methods. Consider a customer shopping for a product at a retail store. The customer can instantly get comparative price quotes from a dozen other sources and make an informed decision about whether to purchase the item electronically and wait for it to arrive, or to pay a premium to take the product home immediately. Several companies offer comparative shopping sites that make it easy for customers to check prices on their cell phones. With GPS chips, cell phones also provide the ability to expand location-based applications, including advertising. For example, Google maps enables companies to advertise businesses, such as restaurants, that are displayed on a map when the customer searches for an address. With a little additional effort, the restaurant could offer coupons or make it easy for customers to make a reservation or check waiting times.

A newer use of cell phones is to tie shopping into social networks. Several companies encourage shoppers—particularly women—to share potential purchases with friends. For example, try on a piece of clothing virtually and let friends vote. Even basic tasks such as reviewing products and recent purchases for your friends to see might lead to increased sales.

Taxes

When do consumers and businesses pay sales taxes on the Internet? Sales taxes present a problem in the United States. Most states tax sales of products and services to obtain revenue to pay for public services. Many municipal governments add their own sales taxes to cover costs of local services. Consequently, over 7,800 separate tax districts exist, with the possibility of several thousand—based on each city. The system works reasonably well for small stores located in one district. But businesses that operate in more than one district must register and file tax forms within each district.

If the sales tax rate were the only issue, the situation might not be too bad. The difficulties multiply because each district has different categories of products and different taxable items. An item taxable within one district might not be taxed within a second. A third district might place the item in a different category and impose different taxes.

The interesting legal aspect of the taxes is that they are defined as use taxes on the citizens—and are supposed to be paid by consumers regardless of where the product was purchased. Since consumers are generally slow to volunteer payments, the states require businesses to collect the taxes and forward them to the appropriate agencies. This situation causes problems when the business is located in a different state. At various times, states have attempted to require out-of-state firms to collect the taxes, but the U.S. Supreme Court has always ruled that the U.S. Constitution clearly forbids the states from taxing interstate commerce. The fact that it is a constitutional issue is important, because it would require a constitutional amendment to change the situation. Congress has discussed creating a simpler tax system, but it is unlikely that it will pass as a constitutional amendment.

Local merchants often complain about the difficulty of competing with out-of-state firms that do not have to collect taxes. However, these same firms could

Reality Bytes: How Do People Communicate?

Texting, or short-message service (SMS), grew to huge volumes in the 2000s. In the second half of 2010 alone, U.S. cellphone users sent more than 1 trillion text messages. Although the number seems huge, it actually represents a slowing of the growth of text messages. Eelco Blok, CEO of Dutch provider Royal KPN NV, noted that the company's youth-oriented brand saw an 8 percent decline in SMS messages in the first quarter of 2011. As the number of smart phones increases, vendors are adding apps to send text messages over Internet connections, bypassing the phone company SMS system. This distinction is critical to the mobile phone carriers. AT&T and Verizon, the biggest carriers, charge $20 a month for unlimited texting. This huge price provides at least an 80 percent profit margin, compared to 35 percent for data or voice. If customers switch from texting, carriers will need to make up the lost revenue through data prices.

Adapted from Anton Troianovski, Carriers Sweat as Texting Cools Off," *The Wall Street Journal*, June 8, 2011.

sell into other states, so the issue could be neutral. Also, consumers who want to touch the product and bring it home immediately are still going to buy from local merchants. More important, state and local governments are concerned about losing their tax base. If consumers shift more of their purchases to e-commerce, the states will lose substantial revenue. For instance, consider the fact that Dell is one of the leading retailers of personal computers—relatively expensive items. Yet Dell has a physical presence in only a few states, so they do not collect taxes for most of the sales. This multi-billion-dollar industry represents hundreds of millions of dollars of annual tax revenue to the states. On the other side, some large companies, such as Cabela's (Idaho Statesman May 8, 2007), have argued that their mail/Internet companies are distinct subsidiaries from their physical stores; and sales from the Web site remain nontaxable, even when a physical store is opened in a new state. Ultimately, states will have to increase other taxes to compensate for this lost revenue. Since most economists consider an income tax to be more progressive than sales taxes, the effect is not all bad.

Sales taxes on services are an even trickier issue. Since a large portion of the GDP is based on services instead of product sales, many states have begun taxing services. In 2003, Congress allowed the federal moratorium on Internet taxes to expire. States are now free to charge taxes on Internet connections. Just as you now pay several dollars a month in taxes and fees for telephone service, you might be asked to pay more for your Internet connection.

Global Economy

Does the Internet create a global marketplace? E-commerce has the potential to open up the global economy. Theoretically, anyone with access to the Internet can purchase products directly from anywhere in the world. However, actual practice cannot live up to the expectations of theory. Three major issues still limit international trade: (1) transportation costs, (2) national policies, and (3) payment and trust limitations.

Transportation costs will always exist, but they can be relatively high for individual orders. International bulk shipments are considerably more economical,

- Fixed monthly fee
- Cost per processing
- Data storage costs
- Data transfer in and out
- Database/software fees
- Examples:
  Amazon: Elastic Cloud (EC2), Simple storage servive (S3)
  Microsoft: Azure and SQL Azure
  Rackspace
  Equinix

Figure 7.29

Cloud computing cost structure. Most costs are variable and it is usually easy to scale up the capacity. Costs will increase but they can be matched to increases in usage.

so there will always be an incentive for retailers to purchase in bulk and resell individual items. Transportation companies consolidate shipments to reduce costs, but customers often want products relatively quickly, and shipping by air is more expensive than shipping by sea.

Nations have many different policies and taxes regarding imports and exports. Most shipments have to go through a customs agent. Even digital products carry restrictions. A few nations attempt to monitor and control all Internet usage—to the point of insisting that all Internet traffic be channeled through government computers.

Think about the consequences if every nation imposed its will on Internet sales. While individual nations do have the right to control sales within their territory, it would destroy e-commerce if every nation imposed its control on all Internet sales. As e-commerce increases in importance, more of these issues are going to arise, and firms will need to have technology ready to handle them.

Global e-commerce is evolving—from many nations, you can buy English rugby jerseys from British vendors. But, the payment mechanisms need considerable work. Many U.S. Web sites will not accept overseas shipments because the risk is too great. Many companies will not sell to nations in eastern Europe, southeast Asia, and the Middle East because the risks are even higher.

Cloud Computing

What are the costs for cloud computing? Many of the e-commerce hosting methods rely on cloud computing. Today, most of the major providers offer virtual machines—where the hosting company runs massive server hardware and hosts independent virtual machines that you can lease. In true cloud computing systems, you pay only for the machines when they are used and you can usually expand the capacities by adding more servers on demand. As shown in Figure 7.29, the basic cost structure can include: a fixed monthly fee, charges based on processing, monthly data storage costs, data transfer in and out of the server, and fees for databases or specialized software.

Amazon is one of the most advanced providers of cloud services. The company offers three major services: virtual machines in the Elastic Cloud (EC2), data storage with Simple Storage Service (S3), and a couple versions of database access.

Microsoft offers similar capabilities with Azure and SQL Azure. Amazon includes calculators on the Web site to estimate monthly costs based on expected usage rates. Data transfer costs are a large component of the total bill, but they typically increase only as the site usage increases. Presumably, increased use and data transfer leads to more sales revenue to cover the costs.

Summary

E-business is a complex topic. On one hand, the Internet and mobile commerce simply represent new ways to interact with customers and handle transactions. On the other hand, they have the potential to change the economy and society. The Internet continues to expand into more areas business and consumers' lives. Businesses at all levels need to find new ways to connect to customers, while staying on the right side of the thin line of privacy—which keeps moving.

Businesses have many ways to make money on the Web and with mobile commerce, but ultimately, revenue comes from sales of products, sales of services, or advertising. Although anyone can make money with advertising thanks to Google AdSense, currently a handful of firms receive the bulk of Web advertising dollars. So, you should probably think about finding ways to sell products and services.

Advertising on the Web is straightforward—but also controlled through a few primary sites. Google is the main advertising point on the Web and it controls most of the keyword search ads as well as banner ads through DoubleClick.com. You should be able to use Google's keyword tools to find keywords, estimate the bid prices for them, and establish a daily advertising budget.

E-commerce sales can be analyzed in three phases: prepurchase, purchase, and postpurchase. The prepurchase phase consists primarily of advertising, providing specifications, and product configuration or selection. Purchase largely consists of handling the transactions, including verifying the customer, protecting the data transmissions, and handling the money transfer. Postpurchase support includes service, problem tracking, and cross selling.

Developing and hosting Web sites is a relatively complex business. Most companies choose to outsource these activities to specialists. However, it is relatively easy for small businesses to create a Web site and begin selling items online. The Buy Now button approach is relatively inexpensive and easy to experiment with. Web auctions are useful for unique items, particularly when the value is uncertain. Amazon WebStore is a good alternative for small businesses that want to sell products online to an established set of customers, without the costs and hassle of building a separate brand name. More complex sites, such as Web services are still built with custom programming, but several firms can help develop and host these new services.

Mobile commerce is similar to e-commerce, but the wireless capabilities can provide some interesting applications—particularly for B2B e-commerce. Sales taxes and the Internet are a challenging problem for states. Ultimately, states will have to alter their tax systems. Similar problems arise on a global scale. Many issues involving customer authentication, payment validation, and national control need to be resolved before global e-commerce can seriously expand.

A Manager's View

Making money on the Internet is not easy, but it is possible. Internet sales are increasing faster than sales through traditional channels. The challenge is to use the Internet to increase your sales while still maintaining existing relationships. New services are being created and the sales of digital products are expanding. M-commerce offers the potential to provide another shift in business and society—but it will be a while before the hardware, networks, and software become widespread enough to make a difference. You need to understand how customers use Web sites to purchase products. Attracting customers or making money through advertising requires a thorough understanding of Google's keyword sales method. Developing basic sites and finding hosting companies for them is relatively easy. Creating custom service applications is still difficult. Choosing the right hosting approach is a key step in getting online with an affordable system.

Key Words

application service provider (ASP)
auction
bill presentation and payment
business to business (B2B)
business-to-consumer (B2C)
catalog management system
click-through rate
co-location
commerce server
content management system
digital rights management (DRM)
disintermediation
e-business
intellectual property
near field communication (NFC)
search engine optimization (SEO)
simple object access protocol (SOAP)
social networking
static HTML
Web 2.0

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Amazon (S3)	aws.amazon.com/s3/
Microsoft Windows Azure	www.microsoft.com/windowsazure
Microsoft SQL Azure	www.microsoft.com/windowsazure/sqlazure
IBM	www.ibm.com/cloud-computing
Savvis (CenturyLink)	www.savvis.com
RackSpace	www.rackspace.com/cloud

Review Questions

1. What types of products are easy to buy online and which ones are difficult to sell solely online?
2. What are the potential benefits and costs to disintermediation that can be accomplished with e-business?
3. How does B2B differ from B2C e-commerce?
4. How does EC differ in the three areas of prepurchase, purchase, and postpurchase?
5. How do Web 2.0 sites make money?
6. What are the primary payment risks in e-business and how do firms reduce the risks?
7. What options are available for promoting a Web site?
8. What choices do advertisers need to make when dealing with keyword ads?
9. What options are available for building and hosting Web sites?
10. How do people use cell phones when making purchases?
11. Many people were concerned that by not requiring EC firms to collect sales taxes, traditional firms would eventually lose business and the states would suffer large declines in tax collections. Why did this scenario not happen? Might it still happen in the future?
12. What problems make it difficult for EC to be global?

Exercises

1. Choose a non-digital item that can be purchased online. Find at least three sources for it and compare the prices. How can different prices exist for the same item?
2. Using the Web or by talking to retailers, find a company that only sells through retailers. Or, find a company that sells direct, but only at list price. What characteristics of the product and industry support or encourage this choice?
3. How can the Web site Twitter make a profit?
4. Choose an industry and assume you are running a Web site for a company in that industry. Select keywords that you might use to advertise your Web site. Estimate the amount you would be willing to bid for Google ads on the keywords and specify a budget. Hint: How many people who click-through an ad will become customers?
5. Select a Web site and identify the prepurchase, purchase, and postpurchase elements.
6. Check with a Web advertising site and identify the cost to run a banner ad on the site. Specify the type of ad and the number of times to run.

7. Obtain the financial statements from a publicly traded social network site and identify the major sources of revenue and costs.
8. Research PayPal from the perspective of a vendor and briefly describe what happens if a consumer claims that they never made a purchase that has already been shipped.
9. What percentage of apps in the mobile market are for games, books, or entertainment?

Technology Toolbox

10. Select one of the major Web server tools and identify how it handles multiple languages.
11. Find a reference that identifies the percentage of sites based on Microsoft Web servers.
12. Check your school's course catalog or talk with instructors in computer science and MIS to see which Web technologies are taught at your school. Also check a local community college catalog.
13. Use Dice.com to compare the number of jobs available for the three main Web technologies.
14. Find current costs for processing credit cards through (a) PayPal, (b) Google, (c) an independent merchant processor.
15. Find the current VISA merchant security requirements if your Web site handles credit card data directly. Estimate the costs of complying with the requirements if you are a small merchant.

Teamwork

16. Search for a common product such as a camera and choose three Web sites with at least one of them from a small company. Compare the three sites in terms of their support for purchase, pre-purchase, and post-purchase support; and their use of social networks.
17. Have each person choose a different item for sale on eBay that has similar items for sale at retail stores or other Web sites. Compare the final eBay price to the other prices. Summarize the differences for the team.
18. Assume that a friend wants to start an online business selling jewelry. Have each person find a hosting company that could handle the site. Identify the costs and tools provided by each company. Share the results and choose one to recommend to your friend. Briefly explain the basis of the decision.
19. Assume the team wants to create a new cell phone app. Find estimated data on prices and sales for existing apps. Estimate the costs of developing and marketing an app and use the data to estimate potential profits.
20. Choose a Web site. Evaluate all aspects of the site and write a plan to suggest how it can be improved.

Rolling Thunder Database

21. Identify at least three areas in which Rolling Thunder Bicycles could profit from e-business. Be specific, and explain what technologies would have to be added (for instance, Web hosting).

22. Find at least five sites on which it would make sense to advertise Rolling Thunder Bicycles. As much as possible, identify the advertising costs and the demographics of the site visitors.

23. Develop a plan for expanding Rolling Thunder Bicycles into international sales. Be sure to identify any potential problems, and discuss how you will deal with them.

24. Develop a plan for creating a Web-based system for connecting to suppliers. What software would you need? How can you convince the suppliers to cooperate?

25. The management of Rolling Thunder Bicycles cannot decide on a Web strategy. For the three main approaches (simple HTML, auctions, and commerce server), list the primary strengths, weaknesses, and costs as they apply to this company. Make a recommendation and briefly explain your choice.

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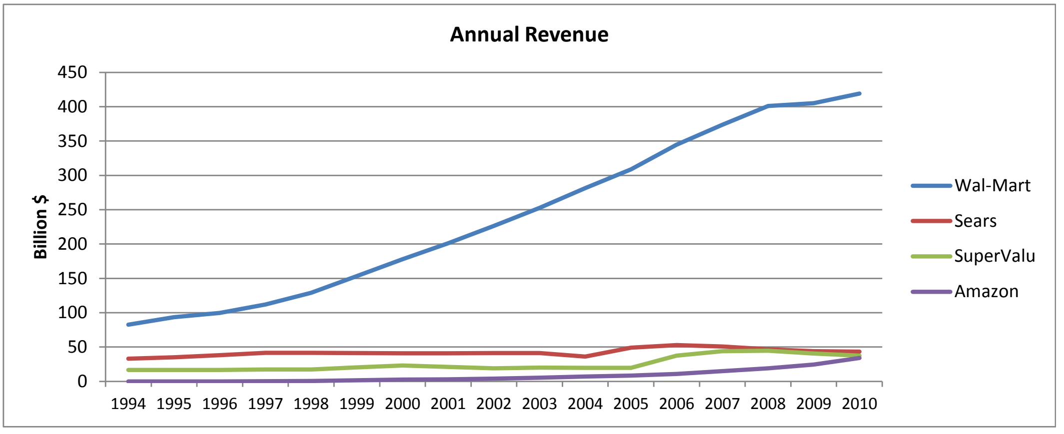
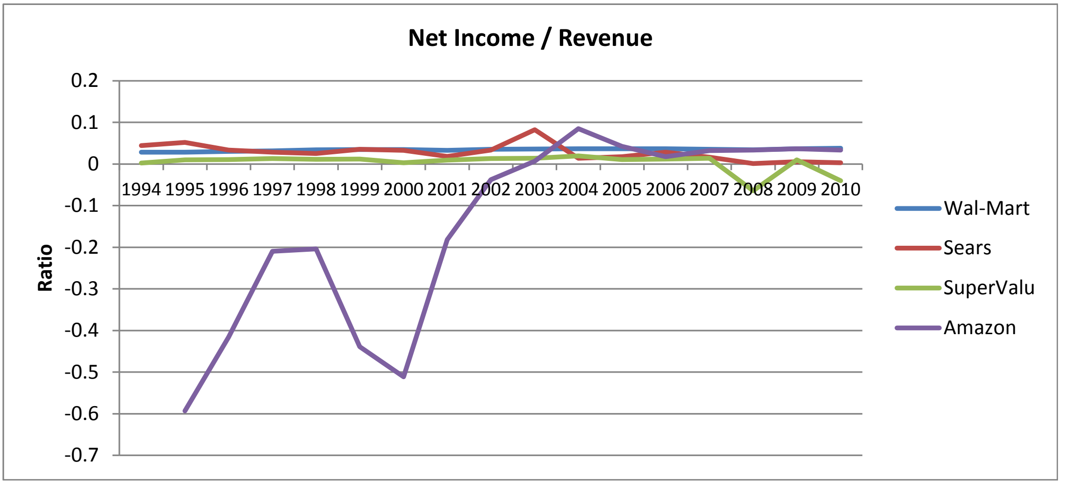
Cases: Retail Sales

The Industry





The retail sales industry includes a broad variety of products, but regardless of the product, several fundamental issues apply. You need to remember that retailers play three critical roles in selling products. The first is location—retail stores succeed by displaying and delivering products where the customers are located. The second is customer service. Many customers need help choosing products and need reassurance—particularly when buying large items. Retail stores also handle returns and take care of any problems that might arise with a product. The third major role played by retailers is to spread the sales risk. Generally, retailers purchase items in bulk. If the items do not sell, the retailer marks down the prices until they are sold. But, the retailer decides which items to carry and what final price to charge, so the retailer takes the loss if products do not sell well. These three services are important to manufacturers. As part of the economics of specialization, manufacturers can concentrate on building products, retailers can focus on customer service, and both firms come out ahead.

Transactions

Tracking sales of individual items and recording transactions are critical factors in retail sales. Originally, retail firms tracked final sales only for themselves. They used the information to help decide when to reorder and when to cut prices. Since the retailer sits in the middle between suppliers and customers, the retailer participates in several types of transactions. Consequently, retailers built important accounting and inventory systems. Recording transactions with customers is relatively easy in theory. The challenge is to keep the costs as low as possible, which is why retailers continually experiment with technology at the checkouts. The retail sales transactions also have to be accurate and secure. Because retailers are generally responsible for collecting sales taxes, the systems also have to maintain adequate audit trails for the state examiners. Retailers also have to track purchases from suppliers. The actual purchase is not that difficult to track, but they also have to monitor shipping and financing costs. Moreover, there are always special orders, and someone has to match received items to orders, monitor quality, and often track down missing or incorrect orders. Increasingly, retail stores also have to build transaction systems to handle the financial aspects as well. As more customers switch to digital payment systems (debit cards), retailers have to work with banks to validate card numbers, verify account balances, and transfer the transaction totals. The detailed financial system must also be able to go back and provide documentation for possible fraudulent transactions.

Supply Chain Management

Today, led by Wal-Mart, the emphasis is on the entire supply chain. A key aspect to reducing costs and improving the profit margin is to minimize the items held in inventory. Or, in retailer accounting language, maximizing inventory turn (over). The ultimate goal might be a just-in-time replenishment system: just as a customer buys an item from the shelf, a new one shows up at the loading dock. Of course, this perfect system is almost impossible. But the profitable stores get closer every year. One key is the ability to forecast exactly which products customers are going to buy, and then build a supply chain so that the right products are delivered on time. Transaction information is a key element in supply chain management. Retailers share their daily sales data with manufacturers, so manufacturers can forecast demand and fine-tune their delivery times.

Supply chains often suffer from what is called the bullwhip effect. A small increase in sales causes retailers to forecast an increase in demand and bulk order more of the product from their distributors. If the increase arises from several stores, the distributor also sees an increase in demand and orders more products. In the meantime, the stores perceive a shortage that is not being filled by the distributor, so they increase their orders even further—to hoard the product and ensure deliveries. The manufacturer sees a giant increase in demand and starts cranking up capacity. The initial small increase in demand has been magnified as it moves up the supply chain. Ultimately, the manufacturer over-compensates and the supply increases too far, raising costs for everyone and depressing prices as the retailers mark down the item to get rid of it. Of course, the fluctuating prices send the wrong signal to customers and can start the cycle all over again. One way to minimize the bullwhip effect is to make sure that all participants have access to the original data on customer demand and that everyone uses the same forecast. Retailers generally support this approach and share their sales data with manufacturers (Hugos 2003).

Of course, a large retail store carries tens of thousands of products and has a few thousand suppliers. So, the retail store needs to be able to integrate with thousands of different systems, or at least provide data in some common format. The massive volume of data also presents problems for storage, access, and transportation across networks. Ultimately, the stores that succeed in handling these data volumes at the least cost are the ones that have prospered.

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Case: Wal-Mart

Wal-Mart (ticker: WMT) represents a classic business technology case. Emphasizing customer service and low prices, the company pushes its suppliers hard. Founder Sam Walton realized early that computers would play an important role in these goals. In the mid-1960s, computers were used to handle basic accounting functions. Counting inventory was still painful because the tools were not available. It was not until 1983 that item-level bar codes were available on the majority of products. Each product was assigned an identifier or stockkeeping unit (SKU) and a standardized bar code. At that point, Wal-Mart installed point-of-sale terminals and was able to track inventory based on the sales. In 1987, the company used a satellite system to link all of the stores to company headquarters. The system enabled the company to compile real-time inventory data ("Dateline" 2002). To reduce the inventory levels, Wal-Mart knew it needed to enlist the cooperation of its suppliers, so the company instituted the collaborative planning, forecasting, and replenishment (CPFR) program to share data with its suppliers. Pete Abell, retail research director at the AMR Research consulting firm, notes that Wal-Mart's "margins can be far lower than other retailers' because they have such an efficient supply chain." He estimates that the company pays 5 to 10 percent less than its competitors for products (Johnson 2002). The suppliers are willing to offer better prices to Wal-Mart because sharing the supply chain management reduces their costs as well. And it does not hurt that Wal-Mart is the biggest company in the world with almost $250 billion in annual sales and more than 1.2 million employees (www.fortune.com global 500).

As America's biggest employer and driven to be a price-leader, Wal-Mart seeks new ways to reduce labor costs. In 2007, the company implemented a new computer scheduling system that evaluates historical patterns and slots employees to cover the busy times and then sends them home during periods with fewer customers in the store. In the process, employees no longer have set schedule shifts.

Instead, they pick up a few hours each day. The system will also improve compliance with federal wage and hour laws—perhaps reducing the lawsuits against Wal-Mart. (Maher 2007).

Supply Chain Management

Wal-Mart led the industry in improving its supply chain to reduce costs. Its incredibly efficient distribution centers are one part of the story. Bulk shipments arrive from vendors at one side of the distribution center. For example, a large truck might be full of identical boxes of laundry detergent. The contents of the truck are unloaded and placed on a conveyor belt. The products are routed through the distribution center to the other side where a mixed load of multiple items is placed into another truck. This load might contain some laundry detergent, toys, and clothes. The mixed load is then taken to a specific store. The computer-controlled distribution center knows exactly which items need to be shipped to each store and loads the trucks accordingly. The system runs by reading the individual bar codes and shifting products to different belts.

In 2003, Wal-Mart shocked many people when it announced that its top 100 suppliers would have to switch to radio frequency identification (RFID) chips in 2005. Initially, the RFID tags would apply only to pallet loads of products. The tags provide some significant advantages over bar codes in the warehouse. They can be read from farther away and do not require perfect line of sight. Multiple tags can be read at the same time (if boxes are stacked together). They are less susceptible to damage. An important issue is that they can contain more data. This last factor is important because it would enable Wal-Mart to electronically record and track the receipt of individual shipments. Bar codes allow it to track only the specific product. A person has to manually match the shipment with the specific order. The main drawback to the RFID approach is cost. Bar codes are essentially free, since they can simply be printed on the box or a label. RFID tags in 2003 cost around 50 cents each. Wal-Mart is hoping that by forcing suppliers to adopt the tags, the bulk demand will convince manufacturers to expand capacity and reduce prices through economies of scale. Wal-Mart's target is 5 cents per tag, and it anticipates that about 1 billion tags will be needed initially (Vijayan 2003).

It is risky to be on the leading edge of technology. Standards are not yet in place and costs are relatively high. The lack of standards is a substantial problem in the international marketplace. As of mid-2004, many Chinese manufacturers were waiting for an RFID standard to be approved before agreeing to use RFID tags. Consequently, some companies might end up having to add the RFID tags after the product reaches the United States (Sullivan June 2004). Several groups have also raised concerns about privacy issues if RFID tags are moved to individual products. Although the tags can be read from only a limited range of a few feet, some people expressed concerns about stores being able to track people by tags placed in their clothes. And if not enough suppliers and distributors install the hardware and software to take advantage of the tags, the entire experiment could be an expensive trial. Some "experts" were suggesting that as many as 50 percent of these trials would fail. Nonetheless, Linda Dillman, CIO of Wal-Mart, observed that the retailer believed it needed to stay on the leading edge of technology. It was important to try technologies that might help, even though the technology eventually might not be useful (Sullivan July 2004). Initial trials with Kimberly-Clark were successful. In April 2004, the company shipped pallets of its Scott paper towels with RFID tags through Wal-Mart's scanners. But Kimberly-Clark has been working toward the RFID system since 2001 (Bacheldor 2004).

By early 2006, more than 300 suppliers were using RFID tags on products shipped through five distribution centers to 500 Wal-Mart stores. Carolyn Walton, VP of information systems noted that out-of-stock items with RFID tags were replenished three times faster than before and the amount of out-of-stock items requiring manual intervention dropped by 10 percent. “We see this as a continual process in an effort to focus on bringing our customers what they want” (Songini 2006). The company intends to push the use of RFID tags through all of its processes. A typical truck delivery carries 7,000 boxes that have to be unpacked and organized. Wal-Mart plans to provide employees with wearable devices that can identify high-priority boxes that need to be unloaded immediately.

Collecting RFID data internally solves some problems, but Wal-Mart is pushing for tighter integration of the supply chain by asking suppliers to share data on the Global Data Synchronization Network (GDSN). The GDSN system builds pools of XML-based data for specific industries and stores. Supplies and merchants upload data and synchronize their own systems so everyone has the current data (Songini 2007 and www.gs1.org).

In 2010, Wal-Mart rolled out RFID tags to track individual clothing items. Initially, the clothing items will contain removable smart tags. Raul Vazquez, the Wal-Mart executive for the Western U.S. noted that “This ability to wave the wand and have a sense of all the products that are on the floor or in the back room in seconds is something that we feel can really transform our business.” Wal-Mart also expects the technology to cut down on employee theft because it will be easier to see which items are missing. Wal-Mart subsidized some of the costs to the suppliers to ensure adoption by its major suppliers (Bustillo 2010).

Tighter Integration with Manufacturers

Procter & Gamble sells $40 billion of household products every year. You know most of their brand names. Despite the use of information technology and electronic ordering systems, Steve David, the CIO, pointed out that returns from retail stores cost P&G $50 million a year. Problems arise from incorrect orders, damaged products, and inaccurate shipments (Stahl 2003).

How can so many problems exist in an electronic system? One of the problems is that every company has a different description and ID number for every product. For example, P&G might have an internal ItemID for a tube of Crest toothpaste. But Wal-Mart will assign a different SKU to each specific size and flavor. The Wal-Mart database might even have a different description for the product than that used by Crest. Both companies probably have even more numbers to describe bulk orders or boxes of toothpaste. Relying on people to match the descriptions or to find items in a catalog or Web site is time consuming and easily causes errors. And manufacturers tend to continually introduce variations or new products and change the numbers. The consulting firm A.T. Kearney estimates that 30 percent of the information in catalogs is incorrect at any point in time (Konicki 2002). P&G alone sells around 60,000 different items.

One answer is to ensure that everyone uses a single standard description and ID of every product. But you have to get all of the manufacturers and retailers to agree to use the system, and someone has to pay for its maintenance. The current answer is the UCCnet registry. It is a not-for-profit subsidiary of the Uniform Code Council (UCC). Ultimately, it makes money by charging manufacturers and retailers an annual fee to use the system (www.uccnet.org). Each item listing contains 62 pieces of product data. By placing it in a single location, all merchants can synchronize their databases to the manufacturer's standard. Errors are reduced when everyone works from the same clean database (Meehan 2002).

With more accurate data, Wal-Mart can rely on EDI to place most of its orders—reducing the costs and time of having employees manually enter each order. EDI has been around since the 1980s, but it carried a high cost because most of the transactions were on private VAN networks that are expensive. In 2003, Wal-Mart began encouraging suppliers to switch to an Internet-based EDI system. To ensure security, most merchants are using the electronic data interchange Internet integration applicability statement 2 (AS2) standard. AS2 provides security through certificate-based encryption. Merchants and producers can use the system either through a Web browser or through low-cost client tools that will connect to their ERP systems (Scheier 2003).

Competition

Competition in discount retail is stiff. Wal-Mart has literally grabbed most of the market from other retailers. For comparison, look to Kmart—which was dominant through much of the nation before Wal-Mart. Because the company did not have the supply chain management systems, and because it did not have the data to forecast customer demand, its stores rarely had the products in stock that customers wanted. Ultimately, it filed for bankruptcy protection because it could not compete against Wal-Mart and Target. In 2000, the Kmart CEO announced that he would spend $1.4 billion on technology—more than the company had spent in an entire decade. The company burned through five CIOs in seven years and went without one for almost two years. The company also had to take a $130 million write-off of supply chain software and hardware that did not work properly. Although spending the money earlier on technology might not have saved Kmart, it is clear that it has provided a competitive advantage to Wal-Mart (Sliwa 2002).

Smaller stores have found ways to use technology to compete with Wal-Mart. Smart & Final, a California-based chain with 225 stores has installed in-store technology to display prices and handle all data processing. The system analyzes demand and can adjust product prices on-the-fly without the need to print new labels or reprogram POS terminals. It also provides immediate sales data to suppliers with real-time access to inventory. Bob Graham, vice president of stores technology noted that "using technology like this is the best way to go up against a particular big company [Wal-Mart] that is taking over the world" (Hall 2004).

In 2010, Wal-Mart began experimenting with a new technology within its Sam's Club—personalized discounts for individual customers. The eValues program runs primarily from a kiosk inside the store. Customers log into the kiosk and the system prints a set of coupons specifically aimed at that customer with discounts on individual products. The members can also get e-mails and view coupons on the Web site. The system analyzes prior member purchases to predict what products each customer might buy and how much discount should be offered (Martin 2010).

Privacy

Wal-Mart collects a huge amount of transaction data, data that includes detailed information on everything customers purchase. Unless payment is made in cash, the Wal-Mart databases also identify the individual purchaser. This data can provide useful insights to manufacturers and marketing companies. In 2001, three retailers (CVS, Kmart, and Wal-Mart) decided to pool their pharmacy sales data and sell up-to-the-minute numbers to drug manufacturers—in exchange for a few million dollars in fees. However, Wal-Mart also made a decision to stop selling general sales data to market research companies. A Wal-Mart spokesman notes that "our competitors were getting more out of the third-party aggregation than we were, so it made more sense for us to stop" (Rendleman 2001).

Financial Transactions

On March 31, 2004, Wal-Mart spotted a problem: 800,000 shoppers were overcharged on their credit and debit cards. The transactions were double- or triple-billed due to a hardware error. First Data Corporation, which clears financial transactions for Wal-Mart, noticed the problem when reviewing one of its quality control logs. The company reversed the duplicate transactions, but Wal-Mart put up notices to customers to double-check their statements (D'Ambrosio 2004). First Data blamed the error on a computer glitch, but did not provide details.

In 2010, Wal-Mart announced that it would replace all of its payment terminals in the U.S. with a version that supports smartcard technology. Smartcards contain a chip to provide additional information, including a PIN; and they are commonly used in Europe. To date, U.S. banks and other vendors have resisted switching to the smartcards; largely because of the costs (Vijayan 2010). It is not known if the terminals will also support near-field communications (NFC); which are likely to be the primary method adopted for cell phone payments.

Online

Wal-Mart has several online systems in place, but they provide only a tiny fraction of sales. Yet the site does get traffic. A test of the site for the 2003 holiday season showed that it was being used somewhat over its capacity—making it sluggish. The site was ranked19th of 20 Web sites. Consumers had to wait an average of 54 seconds to complete an online transaction (Rosencrance 2003).

Somewhat surprisingly, in 2003, Wal-Mart introduced an online music service that charges 88 cents per song—11 cents less than the leading site by Apple. Songs are being provided by Anderson Merchandisers, which acquired Liquid Audio, one of the innovators in digital music. With a somewhat limited selection of songs, it remains to be seen whether customers will use the service (Bartels 2003). Wal-Mart also tried to compete with NetFlix and offer DVD rentals by mail for a monthly fee. That operation was folded after a year of weak demand.

Over time, Wal-Mart recognized that its Web site was not an effective method of selling products. Linda Dillman, executive vice president, stated at the end of 2005 that "we've changed our dot-com presence." The company now views the Web site as a marketing tool. Eventually, the retailer hopes to add online software to help customers organize their data and prepare for trips to the store, particularly in terms of the pharmacy and health care areas (King 2005).

Moving in a slightly different direction for Wal-Mart, it's Sam's Club division started selling a digital health records system to physicians in 2010. The package deal bundled Dell computers with software from eClinicalWorks. The package includes software, maintenance and training and is priced based on the number of doctors in a practice (Lohr 2009).

IT Development

Unlike many of today's large companies, Wal-Mart tends to develop most of its own software. The company is leery of commercial packages because it does not want to be held hostage by the software vendor. The CIO of Wal-Mart also emphasizes that developers have to understand the user's tasks before creating software. Just developing something does not mean it will actually be used. Consequently, before the IT staff creates and deploys an application, developers have to work in the real job. For example, if someone is going to rewrite a point-of-sale application, he or she has to work for a couple of days as a cashier. That way, developers learn what issues are important and what problems need to be solved (Schrage 2003).

Questions

1. Why are some people upset about RFID tags? Are their fears justified?
2. What does the UCCnet project do and why is it so important to retailers?
3. Why did Wal-Mart stop selling some transaction data and will it affect the company in the future?
4. What is the role of Wal-Mart's Web site? Is it a useful tool?
5. Should Wal-Mart continue to rely on developing its own software?
6. What are the benefits and costs to having developers work in a functional area before creating new applications?

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Case: Sears, Roebuck and Co. and Lands’ End

As one of the earliest mass merchandise stores, Sears (ticker: S) has a major place in the history of business in the United States. Richard Sears opened his first store in Chicago in 1887 selling watches and jewelry. In 1896, he began shipping the general catalog that made the company famous. In 1993, the company stopped distributing the general catalog because of the production and mailing costs. Its Craftsman tools and Kenmore kitchen appliances are household icons. In the 1980s and 1990s, Sears acquired several firms that were unrelated to its primary mission. For example, in 1981 it acquired the brokerage firm Dean Witter as well as the Coldwell Banker real estate company. By 2003, the company had divested all of those firms to concentrate on sales (www.searsarchive.com).

Gary Comer founded Lands’ End in Chicago in 1963 with a couple of friends to sell yachting hardware. Over time, the company expanded into luggage, moved to rural Dodgeville, Wisconsin, and took off with direct sales of clothing through its catalogs, telephone operators, and the best guarantee in the business (www.landsend.com). In 2001, Lands’ End had revenues of about $1.6 billion compared with

$41 billion for Sears (Weiss 2002). In 2002, Sears purchased Land's End for $1.9 billion. However, as a wholly-owned subsidiary, the company remains relatively independent—even down to its information technology systems. The merger has had some interesting effects—partly of the success of Lands' End and the number of Lands' End executives who gained power at Sears.

Lands' End used technology to boost sales. In 2001, the company noticed that it was losing sales because products were not in stock. So, in 2002, the company built an inventory-management workbench. The data warehouse system uses an analytic engine to monitor sales and create reports. It automatically alerts sales managers when popular items need to be restocked. The system links to seven-year sales histories in the Lands' End IBM DB2 database. It even contains regional weather data so it can determine why sales of raincoats or parkas increased in an area. With its success, the company created another workbench to help with business-to-business sales, and a third one to help schedule workers in the warehouses (Whiting 2003). In addition, the Lands' End Web site introduced several innovative features.

Online

As a direct merchant, Lands' End presented several innovations. One of its more powerful tools is its virtual model. Customers enter some basic measurement data into the Web site and the system draws a 3-D model to match their body type. From that point, customers can have the model display combinations of the clothes to see how they might fit. Extending on its telephone-based personal services, the Web site also has a personal shopper service. When new styles are released, the personal shoppers recommend combinations to shoppers based on their preferences and prior purchases.

Lands' End built its company by establishing strong relationships with suppliers around the world. These ties enabled the company to offer custom clothing through its Web site. In 2001, the company began offering custom Chino pants for $54 online, compared with standard prices of $30-$40. By 2004, the company was offering custom dress shirts or blouses, dress pants, and jeans as well. In addition to basic measurements, the Web site asks customers to choose among basic body types. The company then has the shirts or pants built to the specifications in a few days. The customization feature is useful because the top reason for returns is that clothing does not fit properly (Swanson 2001).

Land's End quickly learned an important lesson about Internet sales: you still have to provide good customer service, so the Web interface does not necessarily save money. On the other hand, the level of service provided by Lands' End is amazing and generally exceeds that provided by most merchants. For example, a customer called to buy clothes for his wife for Christmas. He had already ordered a charcoal-gray blazer and slacks. He wanted to know if a skirt on a different page would match. The customer service representative put him on hold and quickly called a "personal shopper," who pulled both garments from a rack and compared them to see that they did not match. In 96 seconds, the service representative was back on the phone with the caller with a suggestion for a different skirt that did match and a decision to ship the skirt at no extra shipping costs, since the first items were ordered a scant 12 hours earlier. Although the order was placed over the phone, the same level of service is available online. Bill Bass, vice president of electronic commerce, notes that "one of the great fallacies of the Internet is [that] you'll save on customer service costs because customers [will] serve themselves."

But reducing service costs is not really an important issue to Lands' End. Instead, the company would like to reduce the cost of printing and mailing its 250 million catalogs—which accounts for 41 percent of its operating costs (King 1999).

The site also offers the ability to "shop with a friend." A customer shares a Web site with a friend in a different location. The two see the same products and can communicate via a chat session. To Lands' End, it is all part of customer service.

One of the tools that Lands' End needed help with is the search engine. Actually, few Web sites have had good search engines. Although companies like Google make their search engines available to commercial sites, they are designed to search static Web pages and not product databases. Specialty search companies such as EasyAsk and Endeca have created search engines that enable customers to ask questions in natural languages (e.g., English). The system then searches the database for the best matches (Sliwa 2002).

In 1999, Lands' End launched a global Web site, building the site on IBM's Websphere platform and partnering with Berlitz to handle the initial translations. By 2001, 14 percent of the total sales were outside of the United States. The first sites they added were Japan, the UK, and Germany. A few months later, they added Ireland, France, and Italy by cloning the UK site. Sam Taylor, vice president of international operations, notes that "to launch the French site, it cost us 12 times less than the UK site, and to launch Italy, it cost us 16 times less. That's the beauty of the Internet. It's so scalable" (Sliwa 2001). He also observed that it is considerably cheaper to reach customers via the Internet than through printing and mailing catalogs. However, he also pointed out that the company should not have created the Japanese site first. "There's nothing worse than when your programmers are making changes, and they look at the site to see if it works and they can't read it" [Sliwa 2001].

In 2009, watching sales shrink at traditional stores, Sears began pushing new Web sites and new ways of purchasing products. For instance, the MyGofer.com site lets customers order items and pick them up at a local store on the same day. Common products include groceries, prescriptions, pet food, and some electronic items (Bustillo and Fowler 2010). A similar process can be used to order items and pick them up at a local Sears store. Executives say that online sales have increased by double-digits, reaching $2.7 billion in 2008. Edward S. Lampert who purchased and merged K-Mart and Sears is reportedly more willing to spend money for online ventures than trying to save the local stores.

The Merger

Sears knew that its clothing division was in trouble, even though they sold $4.7 billion of apparel a year. And with the divestiture of its credit card and other unrelated operations, the executives knew that clothing sales had to be turned around. The merger with Lands' End, one of the most successful direct clothing merchants, gave them the opportunity to fix the problem. The Lands' End executives were given control over the Sears clothing department.

Although it was expected, trouble began brewing between the two cultures. The Lands' End group was used to making fast decisions informally. The Sears bureaucracy had multiple levels of red tape. Sid Mashburn, Lands' End's vice president of design and now design chief at Sears as well, refers to the main headquarters as "the Battlestar Galactica" and suggests giving out machetes at the door to cut through the ingrained procedures. He might have been referring to the 29,000 pages of company guidelines that Sears once had (Merrick 2004).

When the Lands' End merchandise was first brought into the 870 stores, sales were weak. Placing $139 cashmere sweaters next to $17 sweatshirts did not help sales of either item. Customers were confused about where to find items. Also, Lands' End executives did not have data on what items would sell, or characteristics of the shoppers. Several items had to be marked down at the end of the season to clear out the inventory.

Jeff Jones, originally chief operating officer at Lands' End, asked if he could purchase data mining software to analyze customer purchases. Executives said that Sears did not use those tools. After some behind-the-scenes negotiations, Jones was finally able to get the tools. Using the software, he was able to learn that the store needed to target more upscale customers—those with incomes of $50,000 to $100,000 or more. Other merchandising experts from Lands' End have been brought in to retarget all of the clothing lines and identify the primary customers. Mindy Meads led groups to picture an image of a representative customer for each of five brands of women's clothing sold at Sears. This routine exercise and the data mining were things that Sears had neglected for years (Merrick 2004).

In March 2005, Kmart purchased Sears. The combined companies are run under the Sears Holdings Corp. name. Karen Austin, the CIO from Kmart was made CIO of the new company (Sliwa 2005).

Technology

In 2002, Sears purchased a huge storage area network from EM to handle a new customer relationship management database. The system will include 95 terabytes of new storage. It will be used to combine data from several inventory databases and existing data warehouses. The system is designed to give the company the ability to examine purchases by customers within the store and over time. As Jonathan Rand, director of merchandise planning and reporting, commented, the company needs to make sure "customers find the merchandise and service they want in our stores, while eliminating what they don't want faster than the competition" (Mearian 2002).

Because the Lands' End division continues to run as a separate subsidiary, Sears did not attempt to merge their information systems. Their Web site and internal systems remain as separate units. This decision minimizes interruptions and avoids causing problems with a system that has been successful.

At the same time, Sears realized that it needed to overhaul its own information systems. In 2003, Alan Lacy, the CEO of Sears, observed that "we've got too many point-of-sale systems, too many inventory systems, too many this, that, and the other thing, because we basically allowed for many, many years each business to do its own thing, which we're not going to do anymore" (Sliwa 2003). However, he also recognizes the importance of keeping the successful Land's End systems separate. In early 2004, Sears announced that it was installing 37,000 Internet-enabled IBM cashier terminals. The connected systems will enable Sears to provide additional types of customer service (McDougall 2004).

In 2004, Sears signed a $1.6 billion 10-year outsourcing contract with Computer Sciences Corporation (CSC). The main elements of the contract cover desktop services, servers, networks, and system management of the Sears.com Web sites. Management of the servers running the financial reporting and sales systems remains outsourced to IBM. The Lands' End operations remain completely independent (Weiss 2004). Less than a year after signing the contract, the company terminated the contract—although Sears and CSC fought over the cancellation fees.

Sales reports for 2007 indicated substantial declines for both Sears and Kmart stores.

Sears also made a decision to recentralize its IT staff. Up until 2003, the staff was split into the various business units such as human resources or credit. The company also moved to standardize its choice of hardware and software vendors. The overall goal was to reduce the number of disparate systems. Cheryl Murphy, vice president of IT operations and engineering, observed that "we're pulling the IT staffs together to get operational excellence and to drive that into the company. We want to find one way of doing things" (Rosencrance 2003).

Suppliers

Sears has been successful in its automotive division in building a relationship with Michelin. In a pilot test with GlobalNetXchange, Sears provides detailed real-time sales data to Michelin. Sears had planned a sale on Michelin tires in June 2002, but even before the sale began, Michelin spotted a problem. Sales earlier in the year had been higher than expected, and the sale would push even more tires out the door. Michelin was forecasting that it would be short 5,000 tires. Since Michelin had direct access to the sales and inventory data, and knew which sizes were selling, the company was able to increase production before the sale began. Hank Steermann, senior manager of supply chain for Sears, commented that "this is a way to manage the supply chain that is good for Sears, because we're fulfilling our commitment to customers, and it's good for the supplier, because they're selling more units than we'd planned" (Konicki 2002).

Questions

1. How can Sears use information technology to improve the sales of clothing—particularly the Lands' End items?
2. What are the benefits to centralizing the information systems and the IT staff at Sears?
3. Given the benefits of centralization, why does every Sears executive keep saying that they will not integrate the Lands' End systems with the Sears systems?
4. If Sears wanted to combine data from the Lands' End financial system with the main systems at Sears, how could they do it without actually merging the systems?

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Case: Super Valu and Albertson's

SuperValu (ticker: SVU) began as the Winston and Newell grocery warehouse serving Minneapolis, MN in 1924. Over the years, the company developed a distribution chain, largely supplying independent and affiliated grocers in the region. Buying other regional distribution chains, the store hit $1 billion in sales in 1971 under the SuperValu name. In 1980, the company moved into the retail trade by purchasing Minnesota-based Cub Foods, operating five stores. From 1990 forward, the company acquired increasingly larger retail-store chains; yet continued to distribute food to unaffiliated stores. By 1998, SuperValu handled 15 percent of the nation's food distribution. In 2006, the retail side expanded massively with the purchase of approximately half of the retail stores (1,100) and distribution network of Albertsons, making SuperValu the third-largest national grocery chain (www.supervalu.com).

Albertsons was a regional grocery chain that grew into the third largest grocery chain in America. Founded in 1939 by Joe Albertson, the company maintains its headquarters in Boise, Idaho. Until its 1999 merger with American Stores, Albertsons expanded through internal growth and creating new stores. The merger with American Stores gave it wider access in California and the Midwest. Some of the acquired stores maintain the original name, such as the Jewel-Osco grocery/drugstores in the Chicago area. In 2003, the company had around 2,300 retail stores and total revenue of $35 billion. The stores were supported by 17 distribution centers [annual report]. Despite the mergers, Albertsons has seen total revenue decline since the 1999 fiscal year. In 2001, the company replaced the CEO by hiring Larry Johnston—who lost out in the GE competition to replace Jack Welch. Johnston quickly replaced most of the executive team. His stated emphasis was to reduce costs and streamline the company, but operating/administrative costs in FY 2003 were higher than they were in FY 1999. Johnston also closed several hundred stores—deciding to focus only on markets where the chain held the number one or two position. In 2006, Johnston sold half the company to SuperValu and the other half to private equity firm Cerberus for eventual liquidation. Johnston walked away with over $100 million in cash for driving a business into the ground.

Competitive Threats

The biggest threat to SuperValu (and Kroger and Safeway and the other big grocers) is Wal-Mart. Wal-Mart now sells more groceries than any other chain in America. Its SuperCenter stores provide a one-stop market for customers, and the company is rolling out more of them every day (Gose 2002). With Wal-Mart's supply chain efficiencies and heavily advertised low-price strategy, customers flock to the stores. Oh yes, and Wal-Mart employees are not unionized. The big grocery chains in California have unionized workers who not only demand high wages, but have gone on strike several times to try and force the wage and benefit policies. With the collapse and sale of Albertsons, it will be interesting to see if the unions can maintain their power to command higher wages (Peltz 2004). Grocery chains gained some breathing room in 2007 when Wal-Mart announced that it was slowing its expansion into the grocery field. In 2006, Wal-Mart accounted for 21.1 percent of U.S. food sales, giving it more than twice the market of Kroger, its nearest competitor. Wal-Mart decided to scale back its expansion plans to avoid market saturation in rural areas and because of stiff competition in cities (Jargon 2007). On the other hand, British supermarket giant Tesco PLC announced plans to place stores in Southern California and Las Vegas—key markets for the new SuperValu.

By 2011, SuperValu operated 1,114 retail food stores and 381 discount food stores, plus handled distribution to 899 discount stores and 1,900 independent retail stores. The company runs 21 national distribution centers. The company distributes and sells all standard grocery and drug-store items including national brands and private labels. The company had about 142,000 employees, with 88,000 of them members of unions. In 2009, SuperValu hired a new CEO; then a new chief marketing officer in 2010 and a new CIO in late 2010. The company experienced a decline in sales for 2010-2011. Even same-store sales declined in many markets—which was primarily blamed on competitors with lower prices (2011 Annual Report).

In February 2007, SuperValu almost got scammed out of $10 million. Two e-mail messages purporting to be from American Greetings Corp and Frito-Lay tried to get SuperValu to change the bank accounts for future payments to these companies. In early March, SuperValu said it transferred $3.6 million to one of the bank accounts, but then double-checked the changes and notified federal law enforcement on March 6. The FBI office was able to shut down the fake accounts and retrieve most of the money. It is not clear if the scammers were eventually caught (Vijayan 2007).

Technology

Transactions processing is a key element to holding down costs in grocery stores—particularly when labor is expensive. Grocery stores were the first to implement bar codes and checkout scanners in the 1980s. Although bar codes provide better data, they do not significantly increase the speed of the checkout process. Someone still has to unpack the cart, move each item by hand over the scanner (sometimes multiple times to get it to read), and then pack the items into bags. Albertsons, like other chains, has experimented with self-service checkouts. Customers with a small number of items run them over the scanner or weigh them and place them into bags. Usually one clerk oversees four checkout stations. To reduce theft, the station weighs the bags as items are added and compares the weight to a known value. But the stations do not really change the checkout process, merely shift some of the work to the customers.

Payment mechanisms are a challenge for grocers. Profit margins are extremely tight and retailers make only a few cents on any item. Customers no longer like to carry cash, but the fees to process credit and debit cards cuts into margins. Check-processing costs at one time ran as high as 75 cents per check. Jacki Snyder, manager of electronic payments at SuperValu observed that "in some cases, the fees on one grocery order exceed $1, more than the supermarket profit on the same order" (Thibodeau 2000). Supermarkets including SuperValu are testing new systems that use fingerprints to identify customers. The Pay By Touch system links the identity to the customer's credit or debit card and also verifies age for purchases of alcohol or tobacco (Sullivan 2006).

Albertson's had just completed an installation of Oracle's ERP system to run operations before the sale to SuperValu. The company was also using PeopleSoft to handle HRM tasks, so Oracle's purchase of PeopleSoft will ultimately benefit the company. Because of the number of stores, SuperValu at least initially is keeping the chains on their existing IT systems. This approach minimizes the problems of integrating data systems and keeps the stores running efficiently, but it makes it more difficult to manage the divisions as an integrated organization.

By 2011, new CIO Wayne Shurts said the IT organization was changing focus from cost-cutting to concentrating on strategic investments. His plans included moving to Microsoft Office 365, the cloud-based applications from Microsoft priced at $10 per user per month. The bundle includes SharePoint and Web conferencing in addition to standard office tools (Nash 2011). The goal is to make it easier for corporate directors to retrieve and share information and comments with other directors and store managers.

Questions

1. Will enough customers use the handheld scanners to make them profitable?
2. If there are 150,000 different items in a store, and LCD tags cost $5 each, how long will it take to recoup the cost of outfitting an entire store with the LCD tags? Remember that all employees are unionized, so assume average wages are at least $10 per hour. Write down any other assumptions.
3. Will new checkout technologies be enough to help Albertsons stay competitive against Wal-Mart? What can Albertsons do to stay alive?

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Case: Amazon

In 1994, with a handful of programmers and a few thousand dollars in workstations and servers, Jeff Bezos set out to change the retail world when he created Amazon.com (ticker: AMZN). Shel Kaphan, Amazon's first programmer, assisted by others, including Paul Barton-Davis, used a collection of tools to create Web pages based on a database of 1 million book titles compiled from the Library of Congress and Books in Print databases. Kaphan notes that "Amazon was dependent on commercial and free database systems, as well as HTTP server software from commercial and free sources. Many of the programming tools were free software" (Collett 2002). In July 1995, Amazon opened its Web site for sales. Using heavily discounted book prices (20 to 30 percent below common retail prices); Amazon advertised heavily and became the leading celebrity of the Internet and e-commerce.

Amazon was often held up as the darling of the dot-com era. Anyone could sell books online, but Amazon showed that you had to be first (or close to first with more money), to capture name recognition and market share. But, looking at Amazon's sales and losses, it is clear that Amazon never made any profits selling books. By the mid-2000s, Amazon altered its strategies on book sales—increasing the price of mass-market books and reducing its inventories to focus on the best-sellers. With the release of the Kindle e-book reader, Amazon significantly jump-started the sale of e-books. By 2010, Amazon was selling 15 percent more e-books than even paperback books (Hamblen 2011).

Amazon sales continue to grow—accounting for a significant portion of online sales. Some of the sales come from partnerships with other sellers—Amazon simply handles the Web site and payment methods. Although sales were increasing rapidly through at least 2011, costs were increasing faster. Most of the costs were investments in new technologies and expanding data centers (Woo 2011). Amazon also continues to sell digital music and in 2011, it expanded its offerings of digital video. Customers who join the Prime club who pay an annual fee to get reduced shipping costs will also get online access to thousands of videos. But, in both music and movies, Amazon remains a small player compared to the Apple and Netflix.

Selling Relationships

As a premier site on the Web, Amazon realized that it could leverage its huge name recognition and trust. The company gradually signed deals with both large companies and small retailers. Customers go to the Amazon site and search for a product. The Amazon database retrieves the product descriptions and prices and displays them in a consistent format. Amazon handles the payment details and sends the order to the partners for fulfillment. Some customers never know they are dealing with a third party. By 2004, 25 percent of Amazon's sales were for its partners. But some of the deals did not go as well as others. In 2004, Toys 'R' Us sued Amazon and Amazon countersued. The primary complaint was that Amazon had promised Toys 'R' Us an exclusive right to sell toys on the Amazon site. But, Amazon signed on many small companies that also sold toys. David Schwartz, senior VP and general counsel for Toys 'R' Us stated that "We don't intend to pay for exclusivity we're not getting." Amazon's initial response was that "We believe we can have multiple sellers in the toy category, increase selection, and offer products that (Toys 'R' Us) doesn't have" (Claburn May 2004). By 2007, Amazon was simply the largest marketplace on the Web.

Small merchants accelerated a shift to Amazon's marketplace technology. For example, John Wieber was selling $1 million a year in refurbished computers through eBay. But increased competition and eBay's rising prices convinced him to switch to direct sales through Amazon. Similar small merchants noted that although the fees on Amazon are hefty, they do not have to pay a listing fee. Plus, eBay shoppers only want to buy things at bargain-basement prices (Mangalindan 2005).

Information Technology

Initially, Amazon built its Web site separately from its order-fulfillment system. The separation existed partly for security reasons and partly because the technology to connect them was in its infancy. One of the most important features offered by Amazon was the affinity program—where customers are shown lists of other items they might want to purchase—based on an analysis of purchases by other customers. It proved to be a useful technology for books, music, and movies—identifying related products that customers might otherwise miss.

In 2000, Amazon decided to overhaul its entire system. The company spent $200 million on new applications, including analysis software from E.piphany, logistics from Manugistics, and a new DBMS from Oracle. The company also signed deals with SAS for data mining and analysis (Collett 2002). But, one of its biggest deals was with Excelon for business-to-business integration systems. The system enables suppliers to communicate in real time, even if they do not have sophisticated IT departments. It provides a direct con-nection to Amazon's ERP system either through programming connections or through a Web browser (Konicki 2000).

The technology and sales did not come cheaply. In 2003, Bezos noted that $900 million went to business technology; $300 million was spent on the fulfillment centers; and $700 million on marketing and customer acquisition (Murphy 2003). That last part largely represents selling books at a loss or offering free shipping while trying to attract customers. Those numbers add up to the $1.9 billion debt, but the company also lost another $1 billion.

New Services

Amazon requires huge data centers and high-speed Internet connections to run its systems. Through vast economies of scale, Amazon is able to achieve incredibly low prices for data storage and bandwidth. Around 2005, the company decided that it could leverage those low costs into a new business selling Internet-based services. The company offers an online data storage service called S3. For a monthly fee of 15 cents per gigabyte stored plus 20 cents per gigabyte of data transferred, any person or company can transfer and store data on Amazon servers (Markoff 2006). Through a similar service (EC2), any company can use the company's Web servers to deliver digital content to customers. Microsoft reportedly uses the system to handle some large files for downloads. The company essentially serves as a Web host, but instead of paying fixed costs, you pay 10 cents per virtual server per hour plus bandwidth costs. Amazon's network can handle bursts up to 1 gigabit per second. The system creates virtual servers, running the Linux kernel, and you can run any software you want (Gralla 2006).

Amazon also runs the A9 search engine, so it began selling keyword advertising. Similar to Google, A9 provides advertising links to other Web sites and shares the revenue. The company also provides mapping and other services that can be integrated into your Web site.

Perhaps the most unusual service is Mturk. The name derives from an 18-century joke where a "mechanical" chess-playing machine surprised European leaders and royalty by beating many expert players. The trick was that a human was hidden under the board and moved the pieces with magnets. Amazon's trick is to use human power to solve problems. Companies post projects on the Mturk site and offer to pay a price for piecemeal work. Any individual can sign up and perform a task and get paid based on the amount of work completed. Amazon takes a 10 percent commission above the fee. For example, the company Casting Words places audio files on the site and pays people 42 cents to transcribe one minute of audio files into text (Markoff 2006).

Adam Selipsky, vice president of product management and developer relations at Amazon Web Services observed that ""Amazon is fundamentally a technology company; we've spent more than one and a half billion dollars investing in technology and content. We began by retailing books, but it was never in our business plan to stay with that" (Gralla 2006).

Amazon has been increasing its online cloud-based services. The main offerings include the S3 service to store files, but also the Elastic Compute Cloud (EC2) and Amazon Web Services (AWS) which enable anyone to buy Web services or any type of computer server and pay just by the amount of processing time used and the data transferred. The company also offers the Relational Database Service (RDS) which provides a cloud-based relational query system. In an interesting twist, Netflix moved some of its main IT operations to Amazon's EC2 and AWS services. Netflix noted that it reduced costs by moving off expensive IBM hardware and they were growing so quickly that it was easier to use Amazon to configure and manage the servers and network bandwidth (Kanaracus 2010).

Questions

1. Who are Amazon's competitors?
2. Why did Amazon create most of its own technology from scratch?
3. Will Amazon ever become profitable enough to recoup its initial investments?

Additional Reading

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 8

Teamwork

Chapter Outline

What You Will Learn in This Chapter

- How can information systems be used to support teams of workers?
- How many different ways are there to communicate with team members?
- Which method is best for each type of message?
- How can several people work on the same documents?
- How does an organization remember past events?
- Where can you find a system that provides these groupware capabilities?
- What if you do not have a server and want to collaborate?
- What could you accomplish if five people work on the same screen at the same time?
- How do you collaborate and share data if everyone uses different software?

FedEx

How does technology help teams work together? Everyone has heard of FedEx—the company that invented overnight delivery of small packages. But FedEx is not alone; it must compete with several other large companies to earn your business. Being on time and at a reasonable price are important attributes to success. FedEx achieves its success through communication and teamwork. Downstream workers have access to information about incoming packages and can alter their schedules if necessary to provide better service.

Since 2000, with several mergers, FedEx has grown beyond overnight deliveries. The company now controls several package delivery and shipping carriers. It also acquired Kinko's in 2004. Information systems are used to integrate these operations and work closer with customers. Ultimately, to FedEx, teamwork entails identifying customer needs and finding new ways to solve problems.

Introduction

How can information systems be used to support teams of workers? Companies are increasingly approaching problems and decisions with teams, often built from members drawn from across the company. Workers can be members of several teams at the same time, and teammates might work in different parts of the country or around the world. Sharing information is a major element of teamwork, and networks are needed to transfer data and share resources. But beyond simple sharing, Figure 8.1 indicates that workers need to work collaboratively on a collection of project documents. Over the past few years, the standard personal productivity tools have gained features to support collaboration and sharing. Additional tools are available to stay in touch with teammates, discuss strategies, schedule meetings, and share research. As a manager, you need to use these tools on a regular basis to become more efficient.

Teamwork is not an invention of the past couple of years. Most teams have developed methods to handle the collaboration needs of the group. Many organizations still use paper-based systems. Paper documents are photocopied and circulated for review. Individuals suggest changes and corrections, which are forwarded to one person. Meetings are held in person—people sometimes fly thousands of miles for meetings, everyone takes notes, and some people dominate the group discussions. Many people still rely on e-mail to send versions of documents. Someday, people will look back and consider these systems to be quaint and inefficient.

Teamwork revolves around two fundamental concepts: communication and collaboration. Teammates need to communicate on many topics, and several communication methods are available today. One challenge is to choose the right communication method for each problem. Collaboration entails working together. Today, that means sharing electronic documents and tracking the revisions made to each document. More than simply combining changes, it also involves discussing why the changes were made. Collaboration also involves scheduling tasks and maintaining project schedules.

Software tools have existed for several years to help with the basic communication and collaboration tasks. The strengths of today's tools are the integra-

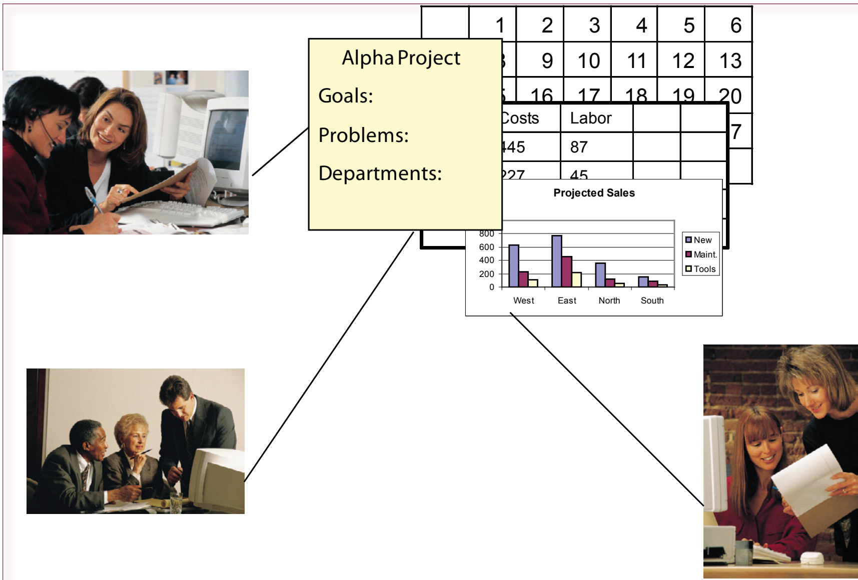


Figure 8.1

Teamwork. Businesses increasingly rely on teams of workers that require coordination and shared documents. Several tools exist to help workers collaborate on common documents, schedule meetings, and track changes.

tion and focus on teamwork. Today, you can automate the business processes by automatically triggering messages and monitoring the schedules and the flow of documents through the company. One goal of these systems is to track the decisions, documentation, and discussions by everyone involved in a decision. If this knowledge is collected and indexed carefully, it can become the foundation of the organization's memory. If you need to solve a difficult problem, you could turn to this knowledge base to find similar problems, or suggestions from workers who faced the same problems.

Communication

How many different ways are there to communicate with team members? Which method is best for each type of message? Communication is a critical element in teamwork. You need to schedule meetings, discuss options, share and revise documents, and identify opinions. Because communication is so important to teams, several technologies are available. You can choose between simple meetings in the hall, phone calls or voice mail, e-mail and instant messaging, and online conferences, or full-blown team meetings. How do you choose the proper communication method?

As shown in Figure 8.2, one of the issues in organizing your daily work life is to manage the interruptions. Phone calls, e-mail messages, people walking into your office, and IM requests all break your concentration. One question you have to answer is to identify which method works best for you (and your teammates). Having multiple channels of communication gives you flexibility. Your goal is to prioritize each technology and method so that you accomplish your goals, yet still

Trends

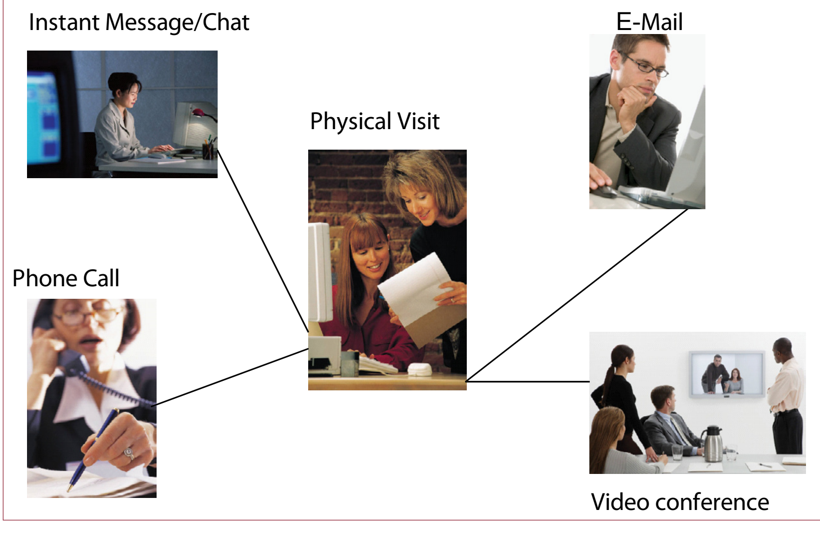
Personal computers originally provided support for basic personal tasks—writing documents, computing totals, and drawing charts. In the 1990s, companies realized the importance of networks for sharing data. In the process, companies realized that networks can change the way managers work. Instead of relying on rigid management hierarchies, small teams can be created to solve problems as they arise. Communication across networks makes it possible for teammates to be located anywhere within the company. Beyond the benefits of communication, can information systems do even more to support teams?

In the 1990s, Lotus Notes revealed the demand for collaboration; but it largely relied on e-mail to transfer copies of documents. In the 2000s, people tried to use Web sites and blogs to communicate and work together, but these tools are difficult to use with multiple contributors and have problems handling office documents.

One of the biggest changes in Office software in the past couple of years has been the introduction of powerful tools to help groups of workers communicate and collaborate. These features were expanded and integrated into Office 2007 which provides SharePoint as a central communication point and SharePoint Workspace/Groove for peer-to-peer sharing. A couple of third-party companies have begun to offer collaboration tools, but they do not yet achieve the integration Microsoft has provided in Office.

Figure 8.2

Communication interruptions. Which type of interruption is the least disruptive for you? Need to finish your work. Need to help the team.



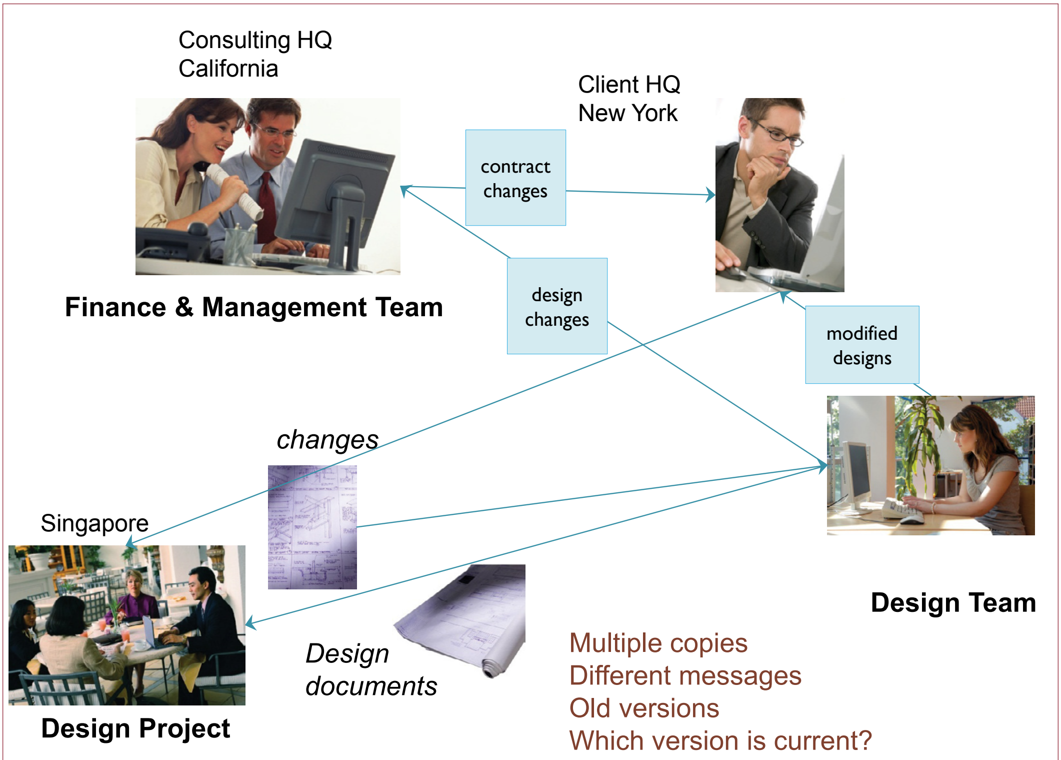


Figure 8.3

Problems with e-mail groupware. E-mail messages with attached documents are sent to team members. But, people end up with multiple copies, they do not receive the same messages, and it is hard to identify the correct version.

have time to work with the group. If possible, you might try to get the group to agree on the priorities of the main methods. Most organizations have a culture that establishes these priorities, but sometimes you need to discuss them so that everyone treats the channels with the same priority.

e-Mail, Instant Messaging, and Voice Mail

E-mail is a relatively common means of communicating. It has the fundamental advantage of being asynchronous, which means that the sender and receiver do not have to be connected at the same time. The recipient can pick up and reply to a message at any time. In a group context, e-mail is even more important because it is easy to send messages to the entire group. Moreover, the messages can be saved and organized so that they create a thread or history of a discussion. E-mail is also used to send documents as attachments.

As shown in Figure 8.3, e-mail systems such as Lotus Notes and Microsoft Exchange were originally advertised as **groupware** tools because of the support provided for attachments. The e-mail systems essentially become moving databases of documents. One of the drawbacks to this approach is that multiple copies of the documents are transferred continually with each message, which makes it

Reality Bytes: Google Apps

Applications to support teamwork are becoming more important every day. The problem is that the applications might not have all of the features people want. Google has been pushing to become a big player in the online market for collaboration with its Web-based Google Apps. In 2010, Google had more than 2 million business customers, including some large companies and several government agencies. The price is attractive to many organizations at $50 per user per year. Google runs all of the servers, provides 25 GB of e-mail storage per user and promises 99.9 percent uptime with 24/7 customer support. But, Google Apps are not the same as traditional desktop software. Aisle 7, a small health and wellness marketing company switched to Google Apps in early 2009. Although the company has only 32 users, only 10 people initially used Gmail. Within three months. Only two people were using Gmail. Aisle 7 also said that over the course of using Google Apps for a year, the company experienced four instances where the servers were down for several hours each. The company eventually switched to Microsoft's online service.

Adapted from Shane O'Neill, "The Trouble with Going Google: 4 Reasons Why I Got Out," *Computerworld*, August 11, 2010.

difficult to track versions and identify the current documents. Plus multiple people might be altering the same documents at the same time, so someone has to merge the final changes into a single document. E-mail is still an important tool for communication, but its drawbacks make it difficult to use as a standalone groupware system.

Texting and other instant messaging tools have become popular in the past few years—particularly with students. However, the technology can also be a time-saver for groups of workers. Each team member can add the others onto the buddy list. The ability to see if someone is online can save considerable time. If you encounter a problem while working, you could immediately see who might be available to answer questions. Yet if you are busy and receive an IM request, you can still choose to ignore it until you have time for a break. But, it is easy for some people to get carried away with text messages; which can make it difficult for others to concentrate on difficult tasks.

Voice mail systems were created so that you can leave phone messages for people who are out of the office or talking to another person. Current voice mail systems have many advanced options, such as the ability to send the same message to multiple people, receive notifications when a message is retrieved, and archive messages for later use. The biggest drawback to voice mail is that some people leave long messages that you have to listen to before they get to the real point of the call. Long e-mail messages are annoying, but at least you can quickly scan the message to find the important elements. It is also difficult to search stored voice mail messages to find particular topics.

E-mail, voice mail, and IM are all push communication technologies. As a message sender, you choose when to place the message and contact the receiver. The other person did not necessarily ask to be contacted, so you are interrupting his or her work. Of the three methods, e-mail is the least intrusive since the recipient has to retrieve the messages and open each one. Because e-mail is less intrusive, you have to remember that any particular message might never actually be read.

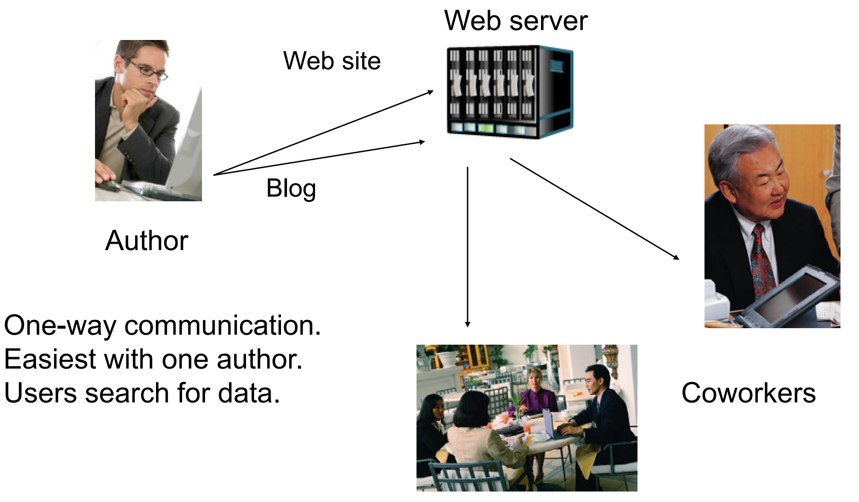


Figure 8.4

Web pages and blogs. One-way communication that is easiest to create with a single author. Comments can be saved and easily searched by coworkers.

It could be buried in a stack of junk messages, or even lost or destroyed. Most systems enable you to ask for receipt confirmation when a message is opened. But these systems are not always automatic. The user can often override this request and tell the computer not to send the confirmation message. Voice mail messages suffer from the same issues and have similar controls. The point is that as the message sender, you need to understand the limitations of the tools. If you need confirmation of a message, it is your responsibility to follow up and make sure the message was received and understood.

Web Pages and Blogs

Web pages were initially created to share information among researchers. As a common platform, you can make files available to anyone on your team—regardless of where they are located or what equipment they are using. Most people are familiar with Web browsers and pages. Several tools help you create Web sites and update documents. Despite these tools, it is challenging to create Web sites and keep updating the pages. As shown in Figure 8.4, Web pages are generally seen as a client-pull technology. You create the Web pages and place them on the site. Team members can view or retrieve the documents, but there is no good mechanism for making changes or replacing the contents. In one sense, Web pages are a broadcast technology, where you can provide the same data to many people. Recognition of this feature makes it clearer when you should use Web sites for communication.

Web logs or blogs were created primarily for individuals to use to create diaries on the Internet. The technology was largely developed to overcome the difficulties in creating and updating Web sites. A blog consists of a site framework that enables others to read your comments. A simple editing tool makes it easy to write daily or hourly comments and immediately post them to the Web. The process is simplified so you can focus on the content. It is also designed to save all of your

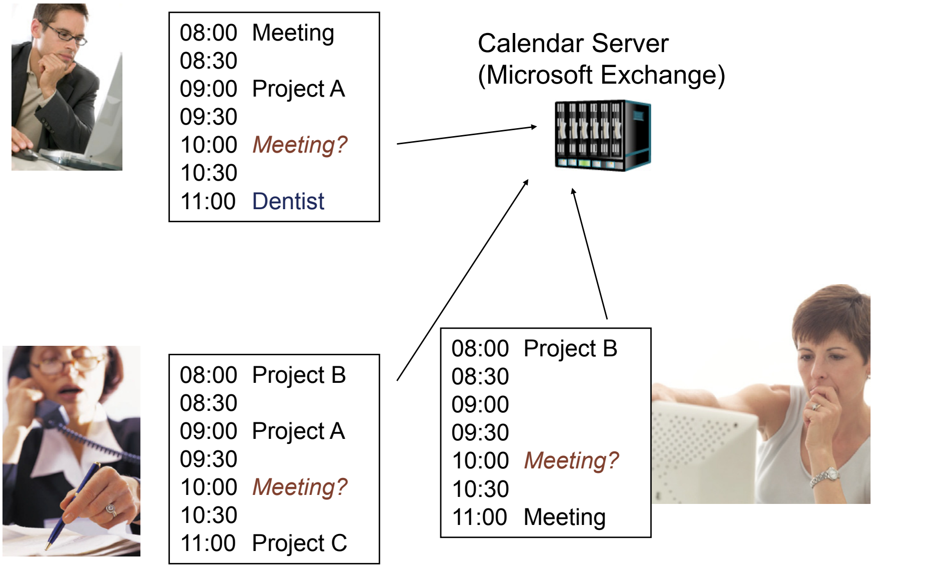


Figure 8.5

Scheduling. When calendars are shared, scheduling software can examine calendars for each participant and look for an open meeting time. Schedules can change throughout the day, so many people carry PDAs or cell phones to watch the schedule.

earlier comments so people can trace the history. These tools could be used in a business or teamwork setting. They would provide a record of the team's actions and decisions. Each person could record current problems, solutions, and describe issues for discussion. Later, if questions arise, you can search the logs to find proposed solutions or learn exactly why a particular decision was made. Of course, you would restrict access to the logs. The big question is whether the team members will take the time to record their thoughts and relevant issues on a regular basis. Blog software is easy to use and you can find shareware implementations that can be installed for little or no cost; so it is relatively inexpensive to test the technology.

Scheduling and Project Management

Scheduling is a challenge with any team project. It is even more complicated when people work on several teams at the same time. Scheduling a meeting or conference is difficult and often requires several messages back and forth just to find a common time. Electronic calendar tools make this process a little easier. Figure 8.5 shows that teammates keep personal calendars that are shared with each other. Each person can check to see if there is an open time slot or use advanced tools to help find the best time for a meeting. Most e-mail systems support shared calendars, but participants generally need to use a common e-mail client. For example, Microsoft Exchange mail server provides tighter integration with the Outlook client software. If you use one of these systems, you need to learn how to mark some items as private, and you need to check the calendar throughout the day as the schedule changes.

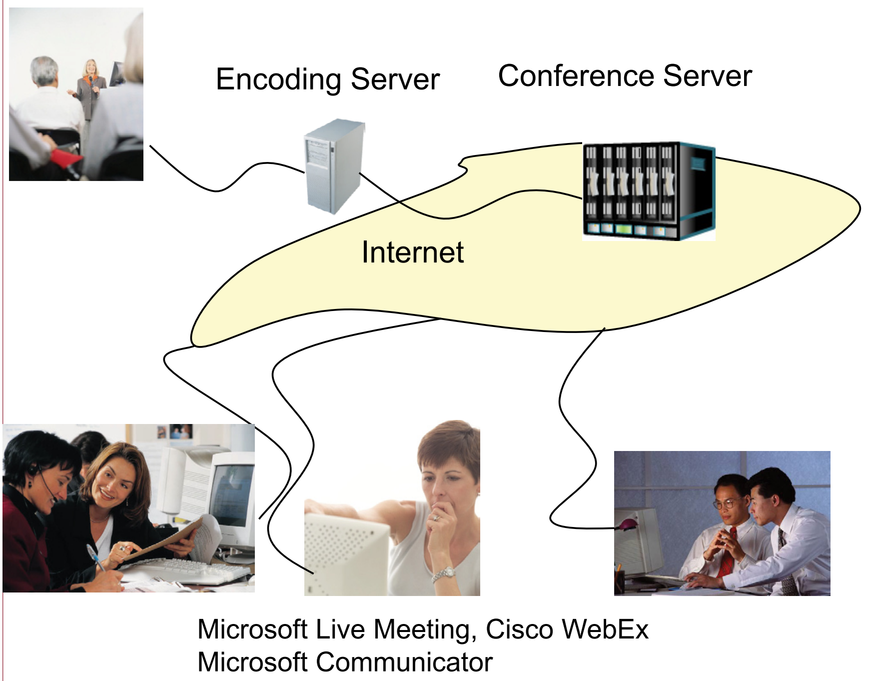


Figure 8.6

Online Conferences. You pay a third-party server (Microsoft LiveMeeting or Cisco WebEx) to broadcast the meeting to hundreds or thousands of participants. Some interaction is supported, but large meetings work best with one-way communication.

However, these tools can also make it harder to plan. If your schedule is constantly changing, you can waste time jumping between projects. For example, you might have a big project presentation scheduled for tomorrow, so you spend time organizing your notes. Then the meeting gets shifted because a higher priority event occurs. You have to rush around trying to collect and organize data for the new meeting.

Project management tools were created to help manage and control groups of workers on large projects. These tools are discussed in more detail in Chapter 13. The basic concept is that you define each task that needs to be accomplished and how these tasks depend on each other. For example, in construction, you must first lay the foundation before you can frame a building. If an earlier task gets delayed, it pushes back all of the dependent tasks. Project management software graphically shows the tasks and their dependencies. As tasks are completed or delayed, the schedule is updated and everyone can see the changes.

Conferences and Meetings

Face-to-face meetings are expensive. Even if everyone on the team works in the same building, a meeting requires everyone to stop their work, organize their presentations, and set aside most other communications during the meeting. If people have to travel to a meeting, the costs are considerably higher. Of course, sometimes the major point of a meeting is to create a deadline that forces everyone to organize their work and meet the project milestones.

As shown in Figure 8.6, several electronic systems have been developed to support online conferences and meetings. At the high end, **videoconference** systems provide real-time voice and video connections so people in different locations can hear and see each other. Videoconference systems require video cameras, microphones, and television displays at each location. For more realistic conferences, some systems use multiple cameras at each location or provide remote control over the cameras. The primary drawback to the systems is the bandwidth required to transmit realistic video data. Early systems used proprietary connections to ensure sufficient bandwidth. Newer systems can run across Internet connections, but require special configurations of routers to ensure the continuous availability of the required bandwidth. The problems multiply if the video signals have to be sent to multiple locations, so most systems operate point-to-point between two locations.

As bandwidth connections improve, lower-cost systems are being developed that enable you to set up videoconferences using personal computers and Web cameras. Be sure to test the systems first because low resolution cameras or slow-speed links can cause more distractions than benefits. While these systems do not give you the remote control capabilities of the big systems, they can support meetings from your desk. They are particularly useful for meetings with two or three participants. For example, systems such as Skype support HD Web cams to provide more realistic images. Cisco and other vendors are using the term **telepresence** to denote high-speed, high-quality connections. But, each side needs a connection with at least 1 mbps transfer rates. For additional fees, the systems can support multiple video connections at the same time. Remember that although broadband connections typically support the speed needed for incoming data, the outgoing data speed can be much lower.

If you do not need video, it is relatively easy to set up a telephone conference. Most phone systems have provisions to connect several people into one conversation. If your company system does not support these connections, you can pay a fee to an external company to host your phone call. Each participant simply calls a special number at the same time to join the conversation. Note that if you have several people in the same room participating in a phone call, you will have to use a special conference telephone. Polycom and Cisco are two of the leading vendors. The phone has a speaker and robust microphone to pick up everyone's conversations. More important, it contains circuitry to eliminate audio feedback. Advanced versions of the phones also support **full duplex** communications, which means that you can interrupt someone speaking—because the phone transmits and receives at the same time.

In part because of the bandwidth problem, several companies have set up special servers with high-speed network connections to enable you to run large conferences online. Microsoft's Live Meeting and Cisco's WebEx are two examples. Essentially, Microsoft or Cisco acts as a hosting company. Your firm pays a fee to use their services—either monthly or one-time, based on the number of participants—which translates to bandwidth demand.

The systems are designed to handle as many as a few thousand participants. The process is oriented to a broadcast approach. A video and audio feed can be viewed by everyone. For reasonably sized groups, you can integrate telephone conferencing to handle interactive questions. The system also includes a standard

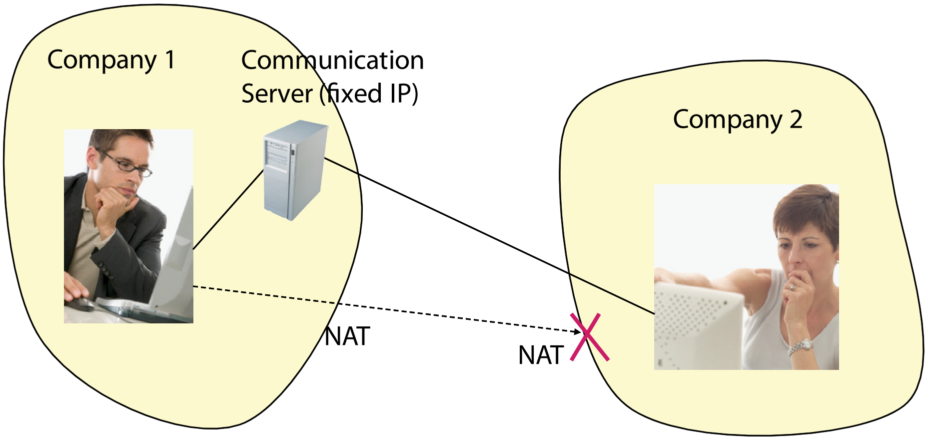


Figure 8.7

NAT complications. Computers cannot connect directly to each other with network address translation. Instead, a communications server with a fixed IP address handles the connections. A company can run its own server (such as Microsoft Communicator), or pay a third party such as Skype. The servers support voice, video, and data sharing.

chat tool if you do not want to deal with the telephone costs. Both systems support Web interaction. The presenter can share applications or the desktop with other participants. Team members can be given control to run an application or annotate a document. You can link in Web sites, where each participant can click on links and fill out forms. A polling tool enables you to quickly create questions and let the audience vote. The system also includes the popular electronic whiteboard where each person can contribute and draw in a different color. Of course, you will probably want to limit these interactive features if you are presenting to hundreds of people.

Microsoft's system also includes a feedback mechanism through a seating chart. At any time, a participant can click the seating chart to request that the presenter slow down or speed up, or to ask a question. The audience notes are displayed to the presenter on a color-coded status board. If you see many requests to slow down (red squares), you know you are going too fast. A useful feature of the system is that it records the presentation so you can save it on your Web site and customers can replay it later.

Peer-to-Peer Network Complications

Chapter 3 explains that most companies use network address translation (NAT) in their routers to isolate their internal networks from the Internet—partly to improve security and partly to conserve the limited number of IPv4 addresses. In summary, each computer within the company's network receives a unique IP address that cannot be accessed by anyone outside the company. As shown in Figure 8.7 although security officers like NAT, it makes it considerably more difficult to establish computer connections to individuals outside the company—including traveling employees, customers, and business partners. In most cases, the best

Reality Bytes: Government Teamwork

In 2010, volcanic ash from Iceland drifted over Europe and shut down air traffic for several days. (High ash concentrations can damage engines.) Jens Stoltenberg, Norway's prime minister was one of the millions of people stranded—he was stuck in a New York airport. So he pulled out his Apple iPad and cell phone and worked remotely. He commented that "There are good means of communication, I have close contacts with my office all the times, and there are a lot of activities in Norway where we try to reduce the consequences of the volcano in Norway."

Adapted from *CNN Online*, "Stranded Leader Runs Country by iPad," April 17, 2010.

solution is to establish a server with a fixed IP address that centralizes the communication links. The server has a fixed IP address and does not use NAT, so it is accessible to people both inside and outside of the company. This approach presents problems for small businesses because it requires the purchase, installation, and maintenance of more hardware. Small businesses will probably want to use third-party companies to handle communication needs. NAT is the second reason Microsoft Live Meeting and WebEx have grown in importance. Other companies, such as Skype, offer online voice communications for the same reasons.

To improve security and reduce costs, larger organizations will probably want to install servers to handle communications themselves. For example, Microsoft provides the Communicator server and client software that integrates with Office. The server also centralizes the management and security issues, making it easier for the corporate IT department to monitor and control the connections and use of the technology. Users who have accounts on the Communicator server can make voice calls using their computer or even a telephone. It also supports video connections, instant messaging, and data transfers. Communicator is integrated with Office, so users can quickly determine which team members are online, send chat messages, or make phone calls with the click of an icon.

Mobile Systems

Messaging and conferencing technologies are fairly well established for traditional environments and meetings. Of course, new features are added every year, so you need to keep up with the changes to see which options might be useful for your particular situation. On the other hand, the telecommunications world has changed markedly in the past decade. People now rely on cell phones, tablets, and wireless Internet access, and want the ability to connect as they travel. As the cellular networks improve, mobile devices are gaining the ability to handle voice, data, and even video connections. For example, the iPhone offers a proprietary video chat system, but it initially works only over WiFi connections. As availability of 4G speeds increases, more people will be interested in using the technology over cell phone data connections—but beware of the bandwidth caps and costs.

Collaboration

How can several people work on the same documents? This question forms the heart of collaboration. One teamwork solution is to assign separate

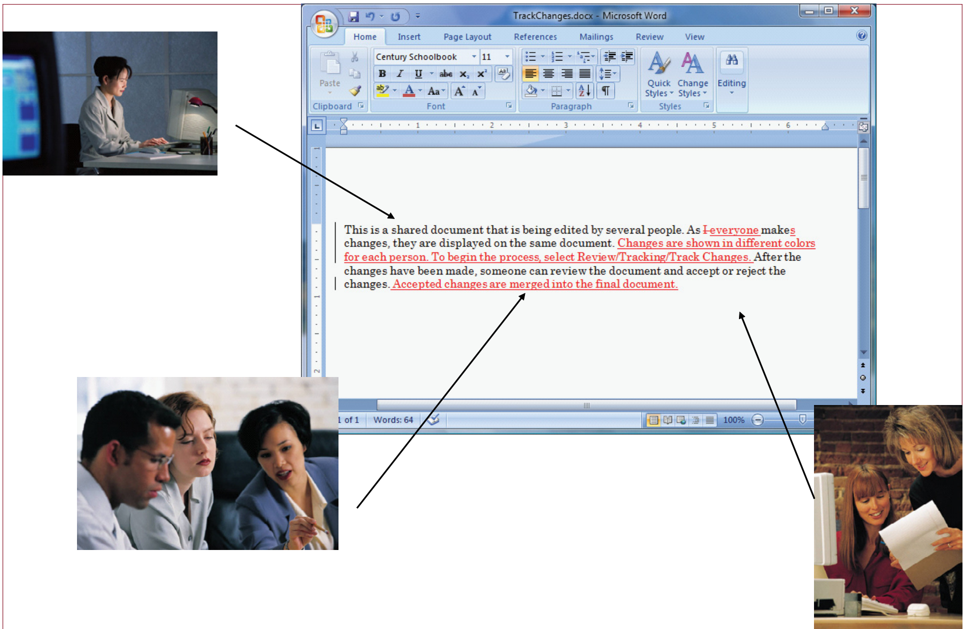


Figure 8.8

Shared documents. By tracking changes, you can record the suggestions by each team member. The toolbar makes it easy to accept or reject the changes as they are merged into the final document.

issues to each person. Working independently, each person creates documents that are then reviewed by the rest of the team. But some projects are not easily divided, and sometimes groups of people have to work together simultaneously.

Networks and e-mail systems make it possible to send documents to each person. But what if you need to identify the changes made by each person? Or what if you need to change directions and revert to an earlier version of a spreadsheet? And how do you handle issues in a hierarchical system where each person reviews a document and approves it before it can be forwarded to the next authority? With paper-based systems, these issues are generally handled by markups and handwritten margin notes. Microsoft Office contains several features that support electronic collaboration.

Documents and Changes

Sharing documents is relatively easy with LANs and the Internet. Keeping track of when changes were made and who made them, or whether you have the current version of a document, is more difficult. One approach is to continually e-mail new versions of documents to everyone in the group, but it is difficult to ensure everyone has the current version—or even knows where the current version is located. Ultimately, the best approach is to store the documents on a central server. These tools are described in the following sections, but you might not have them available; or some people might not be able to access them. Even if you do have centralized tools to handle documents, you might want to track individual changes.

Over the past few years, Microsoft has introduced several changes to the Office software suite. Some of the most important changes have been made to support teamwork. One of the most useful features is the ability to **track changes** in Word documents. Figure 8.8 shows an example. To see the power of this option, begin by creating a new document and typing a couple of sentences. Then choose the Review/Tracking/Track Changes option. Now add a new sentence and delete or replace a few words from an existing sentence. As you make the changes, Word adds markup notes. You can send the document to other people on the team and all changes they make will be marked. When you get the document back, you can quickly see the changes that were made. The Reviewing toolbar contains icons to help you find the changes and accept or reject the changes with a single click. The markup annotations are commonly used for Word documents. For spreadsheets, you need a few more steps because the annotation is different.

The **protect document** options provide additional control over the document. You have the ability to control what changes (if any) other people can make. For instance, if you need to maintain consistency with other documents, you can prevent people from adding styles. You can also limit which team members can edit your document or allow them to edit certain paragraphs or cells in a spreadsheet. Another option is to not allow people to change the actual document but give them the ability to add comments. Adobe Acrobat has similar features that enable you to specify the items that can be changed by other users. You can password-protect the document and limit users to entering form data or allow them to modify the document.

Excel uses the protect document option under the Review ribbon bar to restrict editing to specified people. The Sharing feature also tracks the changes that everyone makes to the spreadsheet. Once you have enabled sharing, you can use the Track Changes option to highlight recent changes. The system also keeps a history of all changes, so you can rollback changes to a prior version—a useful feature if someone makes a major mistake or accidentally deletes important information.

The ability to track changes and restrict changes is a powerful tool for teamwork. At some point in creating work you need to lock down the changes. Even if everyone initially contributes to a document, you need to freeze the changes so everyone can work forward from the same point. If people keep going back and changing costs or plans, it alters the rest of the project planning. The ability to perform these tasks electronically makes it easier to share documents. You no longer have to worry about having multiple copies floating around and trying to find them or trying to identify what changes were made.

Version Control

Version control is a powerful tool both for teams and for individual documents because it automatically saves every revision. Most documents need multiple revisions—whether they are text documents, spreadsheets, or artwork. Have you ever created a spreadsheet, made dozens of changes, and then realized that you were better off with the first version? Multiply this situation by the number of team members and throw in a changing environment. Your manager or client walks in and says that last week's version was much better. Version control systems save multiple copies of every document. As shown in Figure 8.9, each revision is saved independently along with comments and the name of the person who modified the document. At any time, team members can revert back to an earlier version. You can also open an earlier version and copy just a few elements and paste them into the current version.

Region	Sales	Forecast
North	235	312
South	334	416
East	116	268
West	645	879

Monday, initial version, Bob Jackson

Region	Sales	Forecast
North	235	312
South	334	416
East	116	315
West	645	879

Tuesday, new East forecast from marketing

Region	Sales	Forecast
North	235	294
South	334	418
East	116	145
West	645	806

Thursday, marketing implements a new forecasting formula

Region	Sales	Forecast
North	235	312
South	334	416
East	116	315
West	615	798

Monday, CEO throws out marketing formula, reverts to old and modifies West

Figure 8.9

Version control. Each revision of the document is saved individually along with comments. At any time, team members can rollback the changes and revert to an earlier version. Or, they might simply refer to an earlier version and copy sections to be pasted into the current version.

Most version control systems work from a database. You **check out** a file when you want to change it. When you are finished making changes, you **check in** the file and add comments about the changes. The comments can be almost anything, but you want to add enough detail so others understand what was changed. The members of the team should discuss the types of comments and level of detail that you expect to see in the version control system. Ideally, the version control system should be integrated into your file server so that versions are automatically maintained, or at least the team members are reminded to check out/check in the documents.

Version control can be provided in multiple ways: (1) Embedding the versions within the file, (2) Windows keeps versions whenever a file is saved, or (3) Using a central database server to save versions. Microsoft Word used to support embedded versions, but the option was dropped with Office 2007. Excel still supports a history of changes when you create a shared workbook. Embedded versions are easy to create, but can be problematic—there are horror stories of companies sending out Word files to clients without removing the prior versions. Windows supports versioning through its System Protection architecture. By default, it is enabled for the main system drive, but you need to manually activate it for additional drives or partitions. With System Protection enabled, Windows automatically keeps a shadow copy of a file whenever you save a new version. You can browse to the file, right-click it, and choose Restore previous version to pick the version you need. SharePoint, described in another section, has a more powerful system for version control, where all copies are archived in a central database and can be retrieved and managed with version control tools.

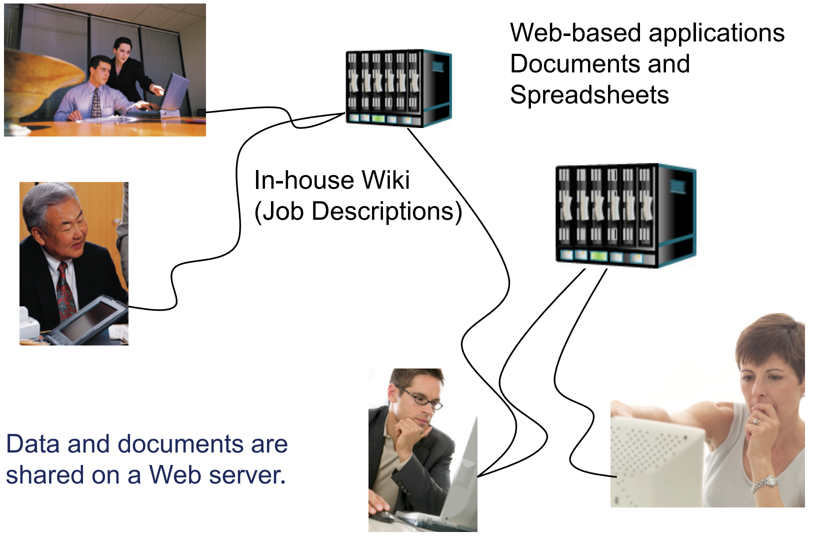


Figure 8.10

Wikis and online applications. Wikis make it easy for people to create work on information together. Web-based applications are designed to share complex word processor and spreadsheet documents.

Wikis and Online Applications

You have probably used the Wikipedia, the free online encyclopedia created by Jimmy Wales and Larry Sanger. The key feature of the encyclopedia is that anyone can create and edit content. What you might not realize is that the underlying Wiki software is available for organizations to use for their own purposes from MediaWiki. Once you install the software, your employees can use Web browsers to create shared content. Drafts can be created and edited by multiple people. Links can be built between projects. Employees can return later to search for information. Effectively, the system can be used much as a giant bulletin board or Web site, but it is easier to create and edit text, images, and video. Depending on the situation, you could even open up the Wiki to your customers, so they can share their stories about how to use your products and services. As another example, the HRM department might use a Wiki to create and manage job descriptions. Managers can share the definitions instead of creating new ones from scratch. Employees could add elements over time, making the descriptions more dynamic and more accurate.

As shown in Figure 8.10, if you need to share more formal documents created by word processors, spreadsheets, and slide shows, you could consider using the online applications, such as those provided by Google. These Web sites enable users to create and share documents on a Web server, where workers use browsers. The Web site maintains the underlying software, so you simply purchase a monthly subscription for each employee. More importantly, the files are stored in one location that can be shared with anyone else in the organization. Because it uses basic Web technologies, authorized employees can read and edit the files from almost anywhere in the world. The application providers (e.g., Google or Microsoft) provide automatic backup and recovery services. Their servers handle

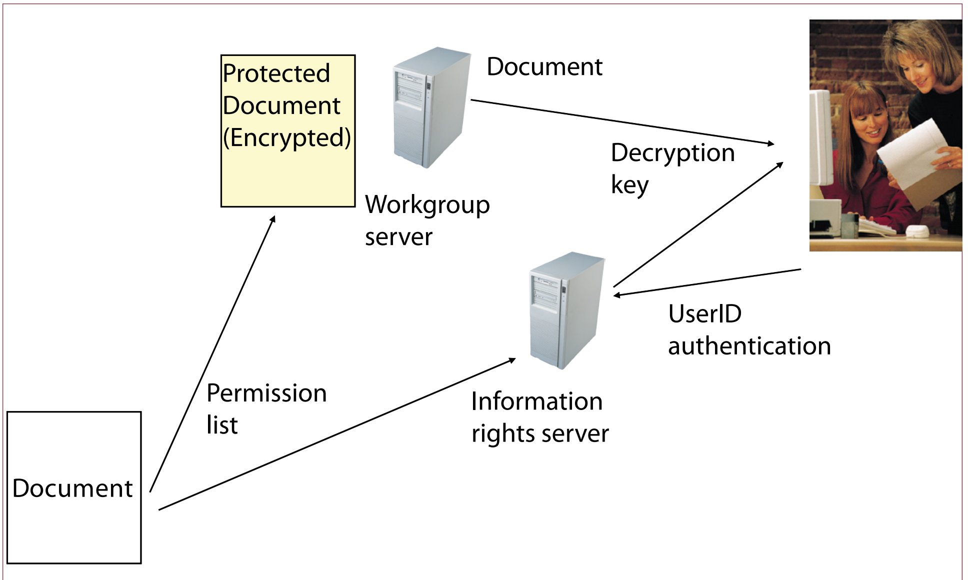


Figure 8.11

Information rights management. Each document is encrypted and the decryption keys are stored on a special server. Users must be connected to the network to exchange authorization identifiers and obtain the decryption key. The document is unlocked but users are allowed to perform only the specified tasks.

most of the traffic, so users can work with fairly simple client computers and moderate-speed Web connections.

Information Rights Management

What would happen if your marketing forecast containing your top customer list and expectations was delivered to your competitors? Or what if your employee list with salaries, bonuses, and manager comments was distributed throughout the company? Obviously, these are dangerous outcomes. How do you prevent them from happening? As explained in Chapter 5, you can store the documents on a server and assign access controls so only certain users can read or change them. But how do you prevent one of the authorized employees from copying the file to his or her laptop or e-mailing it to someone else? The standard solution is to simply trust your employees. But what if you need a more secure solution?

Information rights management (IRM) is one answer to these questions. The technologies are still evolving and few standards exist. The latest versions of Microsoft Office contain some tools to help you control access to documents. As shown in Figure 8.11, essentially every chosen document is protected through encryption, and the encryption keys are stored on a central server. The creator of the document gets to specify the list of people who can open or edit a document. These people are authenticated against the server list, and the server issues the appropriate decryption key to open the document with the specified permissions. Regardless of how the document was obtained (from the server, by e-mail, or a copy on a USB drive), the user must first be authenticated against the information rights server before the decryption key will be issued. Furthermore, you can

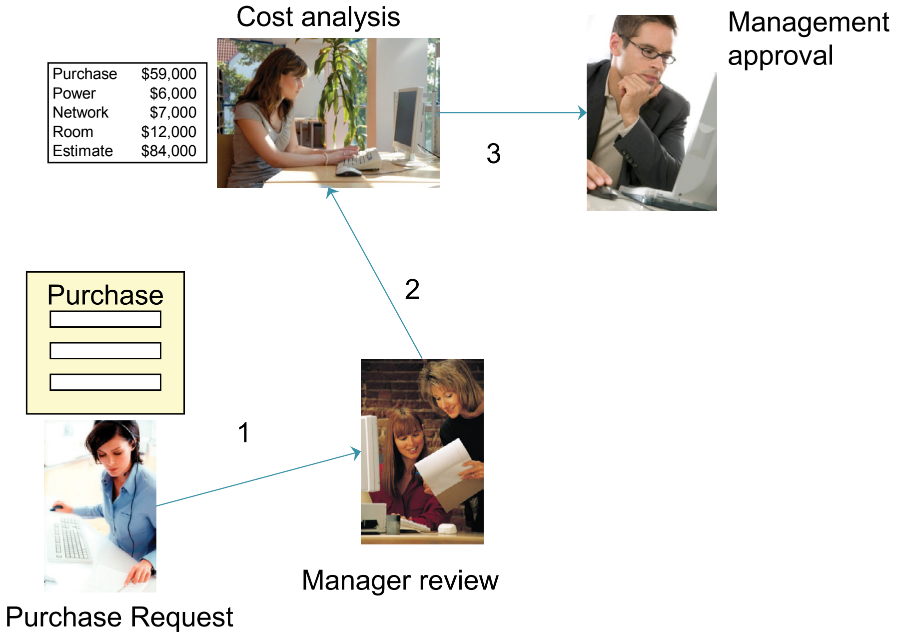


Figure 8.12

Business process management. A large purchase requires approvals and evaluations by several groups. Each event triggers tasks by others. An automated system can track the process and send messages to those involved as the process moves forward.

specify a list of permissions that limit what each user can do with the document. For example, you could prevent the use of cut-and-paste, or disable printing to make it more difficult for authorized users to make copies or spread the document.

The power of information rights management is that the permissions are enforced regardless of how the document was obtained. The main drawback is that you need a server to identify the users and provide the decryption keys. Microsoft provides a trial service to enable you to test the system, but ultimately, you would have to pay to install a Microsoft server to implement their system. To activate the Microsoft system, choose File/Permission within an Office document. You will need a Microsoft Live account or your own IRM server. With independent servers, companies can create detailed customized permission schemes. The IRM scheme also enables you to set an expiration date for content. After the specified date users will not be allowed to decrypt the file.

Workflow

Workflow or **business process management (BPM)** is the concept that some actions have to be performed in a sequence. In particular, documents need to be delivered to and reviewed by various people in sequence. For a simple example, consider a purchase order. You need to purchase some equipment or software for your job. You begin by filling out a requisition form detailing the equipment and how it will be used. You forward the document to your supervisor, who might ask for some revisions or additional data. Once approved, it is forwarded to another manager or perhaps to the MIS department. With additional revisions and changes, the document is forwarded to purchasing and accounting. These departments create purchase orders and obtain responses and information from vendors. Some of the vendor information might be forwarded to you for verification or approval. Ultimately, the item is ordered, delivered, and installed. Remember that this was a "simple" purchase example. Team projects can be considerably more complex with more interactions and more approvals.

In the past, organizations created workflow systems using paper documents and internal procedures. Each document contained sign-off lines to indicate how the document was supposed to be circulated and to highlight the approvals. As shown in Figure 8.12, electronic workflow systems are being developed that provide similar features for electronic documents. Of course, you could just e-mail the document to everyone for approval, but standard e-mail messages do not provide the desired sequencing or the ability to track the current location of requests. Workflow systems work with e-mail but add the desired sequencing that you provide by filling out a sequenced list of addresses. Each person receives the message with attached documents. When finished with the document, the message is forwarded to the next person on the list. Ideally, the workflow system would provide feedback indicators to everyone on the list, so that you could check on the progress of individual items or get a list of items that are likely to show up on your desk in the next couple of days. Microsoft has embedded workflow features into Office and SharePoint, but more sophisticated controls are available through specialized vendors such as Legato. Chapter 6 explains that workflow processes are also supported within ERP packages, because transactions involve approvals and oversight. Some systems support complex rules with conditions and multiple routing. Some even provide programming languages to handle complex conditions and interactions with other systems.

Group Decision Support Systems

How do groups make decisions? How can dozens of people present their ideas and questions? How can you keep track of the various statements and problems raised? Note taking at meetings is the traditional answer to these questions, but in some cases, there is a better answer. Specialized tools such as a **group decision support system (GDSS)** were created to answer these questions. Most versions of a GDSS use a special meeting room, where each participant is seated at a networked computer. A facilitator operates the support tools and keeps the discussion moving in the right direction. Before the meeting, the primary decision maker meets with the facilitator to establish the objective of the meeting. They set up sample questions and design the overall strategy.

Typical meetings begin with a brainstorming session, where participants are asked to think of ideas, problems, and potential solutions. They type each of these into categories on their computers. The basic ideas and suggestions are stored in a database and shared with the group through the networked computers. In some ways, the sessions resemble online forums—where people respond to comments and ideas.

In terms of discussion and comments, the facilitator can choose individual items and project them on a screen for the entire group to analyze. Participants can write comments or criticisms of any idea at any time. This system is particularly helpful if many participants come up with ideas and comments at the same time.

The computer enables everyone to enter comments at the same time, which is faster than waiting for each person to finish speaking.

Another feature of using the computer for the entry of ideas and comments is that they can be anonymous. Although each comment is numbered, they are not traced back to the original author, so people are free to criticize their supervisor's ideas. Anonymity reduces embarrassment and encourages people to submit riskier ideas.

At various points, the facilitator can call for participants to vote on some of the ideas and concepts. Depending on the software package, there can be several ways to vote. In addition to traditional one-vote methods, there are several schemes where you place weights on your choices. The votes are done on the computer and results appear instantly. Because it is so easy to vote, the GDSS encourages the group to take several votes. This approach makes it easier to drop undesirable alternatives early in the discussion.

One useful feature of conducting the meeting over a computer network is that all of the comments, criticisms, and votes are recorded. They can all be printed at the end of the session. Managers can review all of the comments and add them to their reports.

In theory, a meeting could be conducted entirely on a computer network, saving costs and travel time if the participants are located in different cities. Also, if it is designed properly, a GDSS can give each participant access to the corporate data while he or she is in the meeting. If a question arises about various facts, the computer can find the answer without waiting for a second meeting.

Perhaps the greatest drawback to a GDSS is that it requires participants to type in their ideas, comments, and criticisms. Most people are used to meetings based on oral discussions. Even if they have adequate typing skills, a GDSS can inhibit some managers.

Along the same lines, in a traditional meeting, only one person speaks at a time, and everyone concentrates on the same issues at the same time. With a GDSS, your focus is continually drawn to the many different comments and discussions taking place at the same time. People who type rapidly and flit from topic to topic will find that they can dominate the discussions.

In terms of costs, maintaining a separate meeting room with its own network and several computers can be expensive. Unless the facility is used on a regular basis, the computers will be idle a great deal of the time. When you factor in the costs for network software, the GDSS software, and other utilities, the costs multiply. One way to minimize this problem is to lease the facilities that have been established by a couple of universities and some companies (e.g., IBM).

The use of a GDSS also requires a trained facilitator—someone who can lead discussions, help users, and control the GDSS software on the network. Hiring an in-house specialist can be very expensive if there are only a few meetings a year. Again, using facilities from an outside agency can reduce this cost, but it means that someone outside your company is watching and controlling your meeting. Although most facilitators are scrupulously honest, there might be some topics that you do not want to discuss with nonemployees.

One way to overcome these limitations is to alter the approach to meetings. Instead of requiring everyone to get together at the same time in one room, meetings could be held via network discussion groups. Each participant could read messages, add comments, and vote on issues electronically at any time from any location. Again, the Internet offers possibilities to provide these facilities, but it could be a few years before organizations and managers can accept the changes required.

Reality Bytes: The U.S. Patent Office

Many people have criticized the U.S. Patent and Trademark Office (USPTO) in the past few years. The office has issued several dubious patents that many people argue should not have been granted because other systems already existed to do the same thing. Patents are only supposed to be granted for new, non-obvious inventions. Once a patent is granted, the owner gains a huge benefit in any court fight. Anyone challenging it has the burden to prove that the prior work existed and was significant enough to overturn the patent. The patent examiners are also overwhelmed—facing a backlog of more than 600,000 applications in 2006. Patenting software applications takes four years from the date of submission to resolution. The area of patents for computer code is also troublesome because much of the early work was never published since patents for software have existed for only 20 years, there are few databases, and the examiners have little experience with computer code. Several people and organizations have proposed projects that could help patent investigators. The overall goal is to create a knowledge management system that would create a giant library of existing practices—largely by collecting code and tagging it with searchable notes. Manny Schecter, an associate general counsel for IBM observed that the "[they] need a tool that will enable sifting through the code in such a way that's useful to the patent examiner. We should be able to have it done this year." John Doll, commissioner of patents, noted that 'there's a lot within the open source community that's valid prior art, but because of how it's stored, it's not accessible to examiners. We have a hope that if we have a standardized system, we can find it in the future." Others have suggested using a Wiki approach to enable the development community to contribute knowledge, but Doll noted that "the problem we have is we have a statute and we're restrained from opening the examination for anyone other than a patent office examiner." However, he also suggested that it might be possible to allow outside comments between the time the application has been made public and before the patent is awarded. In the meantime, the USPTO is likely to continue granting patents for work that essentially copies things done 30 years ago. The complications are the major reason software was not originally considered patentable, and why Europe does not grant software patents.

Adapted from Eric Hellweg, "The Patent Office's Fix," *Technology Review*, January 13, 2006.

Knowledge Management

How does an organization remember past events? When an event arises similar to one you dealt with in the past, do the employees use the knowledge gained from the prior experience? What happens if several key managers leave your company? These questions are critical to reducing costs, maintaining continuity, and improving the organization. Every organization operates on some type of business processes. Some firms are highly structured and spell out detailed steps to follow in almost any situation. Other companies evolve implicit procedures over time. Many organizations make the same difficult decisions every month or every year. Difficult decisions can require the participation of dozens of employees and analysis of gigabytes of data. It would be nice if the organization could keep the knowledge gained from every decision and apply it to similar problems in the future. In the past, maintaining organizational knowledge was a key management factor in retaining and promoting key employees. But in medium-size and large organizations, turnover, distance, and the challenge of finding experts can make it difficult to maintain and share the knowledge. So, some companies have attempted to create **knowledge management (KM)** systems.

A KM is designed to store any type of data needed to convey the context of the decision and the discussion involved in making the decision. While the system might contain rules, it is primarily a giant database of easily accessible data for experts. KM systems are designed to organize information and to assist people in collaborative projects and research. The system can be relatively unstructured and often consists of many individual cases. Decision makers can search the system for cases with features similar to their current issues. The cases are cross-referenced so that a decision maker might research one aspect of a case and find a related issue. The links make it easy to explore the related issues, tying together a variety of concepts and identifying related problems or consequences.

Because the field is relatively new, the definition of KM is somewhat nebulous and many software vendors promote tools as useful for KM. One of the difficulties is that the decisions and knowledge required can be different for each organization. And organizations may approach decisions differently, so it is unlikely that a single tool will be useful to every company. Instead, each company needs to evaluate specific decisions to determine whether it will be useful to explicitly collect the information and process knowledge that was involved in making the decision.

One of the biggest challenges with KM systems is creating an organizational environment that encourages decision makers to store their knowledge in the system. Initially, the system will have little data, and the early decision makers will have to spend a great deal of time organizing their discussions and creating the files and links necessary to make the system valuable in the future. Companies need to give managers enough time to consolidate their information and provide incentives to encourage them to help build the new system.

Organizational Memory

Organizational memory represents the knowledge held within the company and the processes and procedures used to perform the primary tasks. Imagine what would happen to an organization if all of the managers retired on the same day and all of the procedure books and documents were destroyed. All of the business processes would have to be reinvented. Sometimes reinventing new processes can result in more efficient systems (known as process reengineering). But it takes time to re-create all of the knowledge.

Now, think from a more positive perspective. How can information technology be used to improve organizational memory? Perhaps some events occur only rarely and no one remembers them. Or, perhaps employees try to re-create the wheel for every new event. If you can store the organizational memory in a searchable database and make it easy to use, employees can turn to it to obtain fast, accurate answers and even solutions to current problems.

One of the challenges to KM lies in getting everyone to use the system. Many times it is hard enough to solve a current problem. Most workers will complain about the lack of time to enter all of the issues into the computer. For that reason, KM has to become part of the groupware project. Employees need to store the information so that they can share it with teammates. Organizing it for future use is

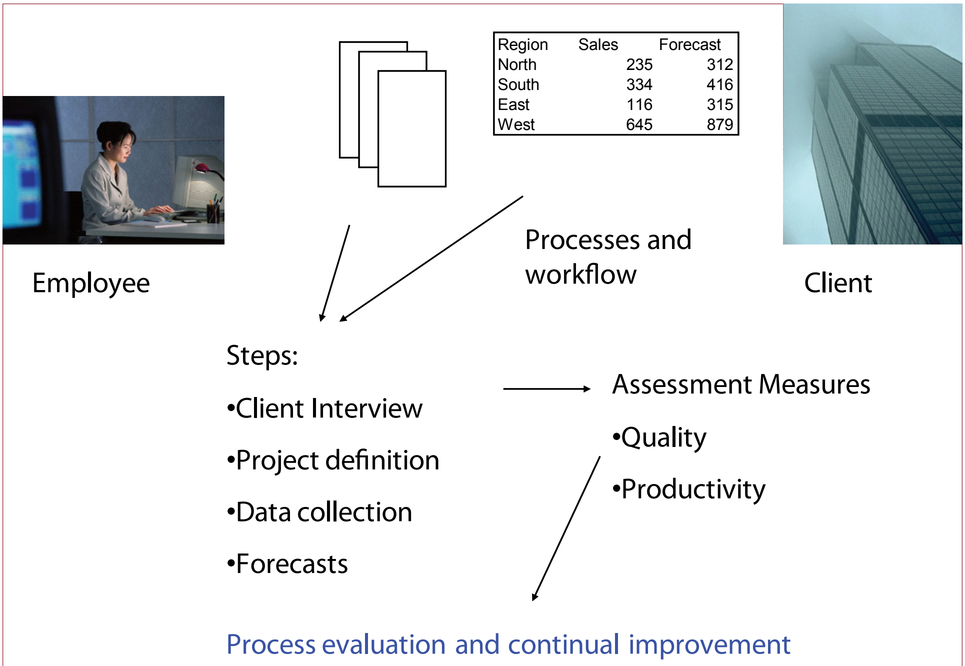


Figure 8.13

Service process improvement. A major step in quality improvement is to document each step and provide an assessment measure. Ongoing evaluation of the processes and measures shows you what areas need improvement and measures your progress.

almost a secondary consideration. By using the system to gain immediate advantages (collaboration and instant access to data), employees will have an incentive to store the information—creating the organizational memory in the process.

Service Processes

Service firms probably have the most to gain from the use of a KM system. Production systems typically already have engineers and support firms testing new ideas and tracking problems. This production knowledge is often saved explicitly or discussed as a professional discipline. Service firms such as lawyers, doctors, and financial institutions, have less specific processes. Often the service is dependent on one or two people within the firm.

As shown in Figure 8.13, documenting the processes makes it possible to improve the quality of the service. For example, a major premise of the ISO 9001 (and related) quality standard is that all processes need to be documented. You also need to assign measures that enable you to identify problem areas and measure your progress when you make changes. Theoretically, you could write all of the documentation and assessment on paper forms and stash them in a file cabinet. A more useful approach is to store all of the documents and assessment measures and comments in a KM system. The electronic system makes them available throughout the company so that everyone can find the appropriate process, can see the reasons and interactions for the process, and can suggest improvements.

Communication	
Contacts	E-mail
Chat	Discussion
Survey	Lists
Project Management	
Tasks	Schedule
Calendar	
Collaboration	
Libraries	Shared documents
Tracked changes	Version control
Wiki	
Workflow	
Routing	
Alerts	

Figure 8.14

Microsoft SharePoint overview. SharePoint Server provides several useful tools to support teams and collaboration. It requires running a server, but it also integrates well with Office.

Microsoft SharePoint

Where can you find a system that provides these groupware capabilities? The benefits of the tools are relatively strong, but will it be expensive and require huge amounts of training to get workers to use these tools? In some cases, the answer is yes. Depending on your needs, you can buy specialized products in most of the groupware categories. On the other hand, Microsoft has integrated groupware tools with Office using the SharePoint product. As shown in Figure 8.14, SharePoint is a set of utilities that reside on a departmental server designed largely to share documents over the Web. Currently, Microsoft offers two version of SharePoint: (1) SharePoint Server is a "free" add-on with Office and Windows Server, and (2) the enterprise version which must be purchased separately. The discussion and capabilities described here are based on the free version. Although the tools may not be perfect, they are relatively inexpensive and easy to use. Consequently, you can install them and get employees using them fairly quickly. In terms of the cost, keep in mind that you will probably have to install a departmental server.

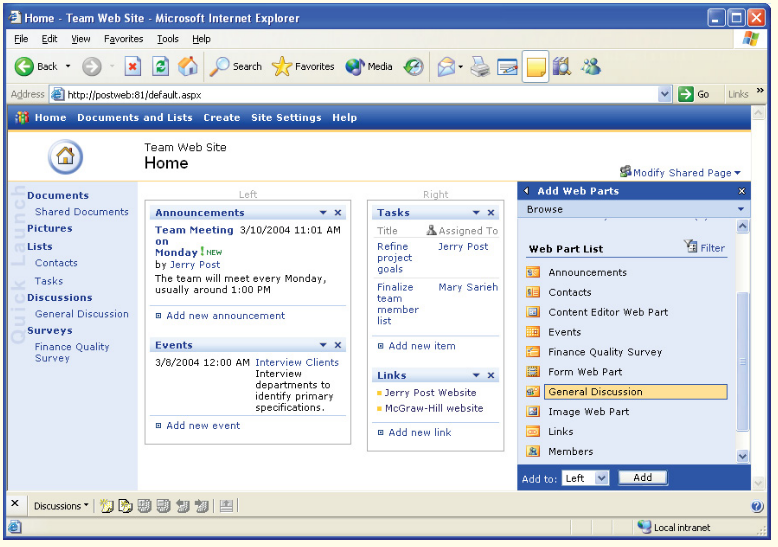
Most of the SharePoint tools use standard Web protocols, so authorized users can use them even when they are traveling. A special Web site has to be created to support the tools. Generally, this Web site should be run on a company server, using standard security precautions. If you want higher security, you can run the Web site as a secure site and encrypt the data transmissions. Small companies might consider obtaining the service from their ISPs. Participants are required to log in to the system, and security controls can specify detailed access rights.

Communication and Scheduling

It is always amazing to learn how difficult it is to contact everyone on a team. People work on many projects, at different times, in different locations. Consequently, even simple information can be hard to share. Basic announcements are useful for these situations. Announcements are short messages that are displayed

Technology Toolbox: Collaborating with SharePoint

Problem: You need to collaborate on a project with several workers.
Tools: Several groupware and collaboration systems have been created in the last decade, but SharePoint is probably the easiest to configure and use since it is integrated with the standard Office suite.



The drawback to SharePoint is that you really need a departmental server running the latest version of Windows Server software. You also have to ensure that everyone has an account either on the server or on Active Directory. These issues are relatively minor in a business setting, but they can be a hurdle in an educational environment. Once you have the server configured with the SharePoint extensions, you use the administration tools to create a new team site and add members. You can specify the role of each participant (browser, contributor, administrator). The system makes it easy to e-mail each person to notify them of the site. When you configure the server, be sure to setup the e-mail server so participants can set alerts for changes.

You can configure the home page of the team website with the Modify options. For example, you can choose which items (Web parts) will be displayed and where they are located. The main page is essentially a portal for the team that organizes all of the work. Each person can also customize the home page with additional options. For example, you can have the page display all of the contacts or provide links to messages. Each day when you log on, you can check for urgent messages or examine the progress on the task list. Programmers can create additional Web parts and customize the data displayed on the site. Microsoft includes some pre-built parts such as weather or stock feeds from MSN. By customizing the home page for each project, workers can focus on the most important tasks and monitor progress. Additional features and the standard tools are only a couple of clicks away for any team site.

Quick Quiz:

1. Why would you want to configure the home page differently for different projects?
2. Is there a limit to the number of people you would want to place on a SharePoint team?
3. Research the two products and list the additional features provided by SharePoint Portal.

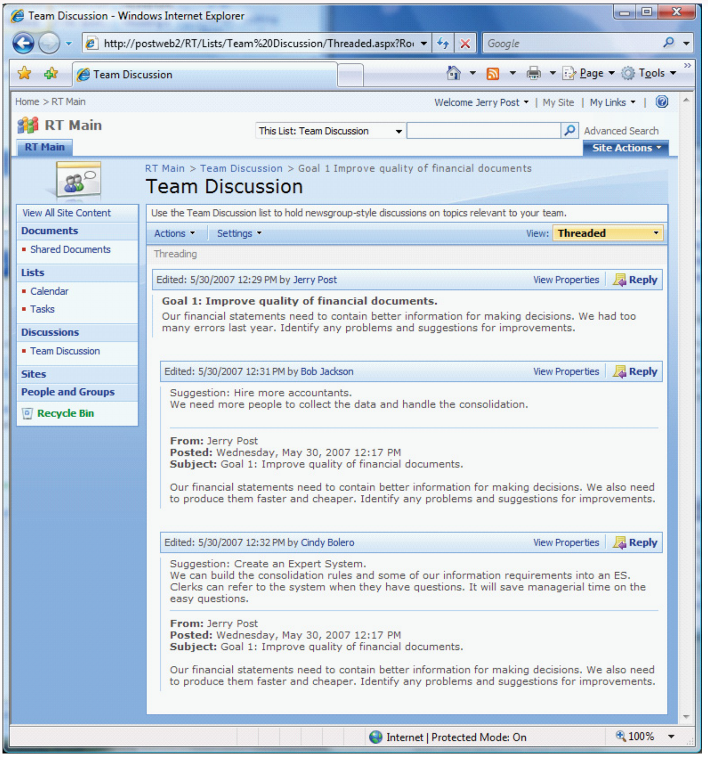


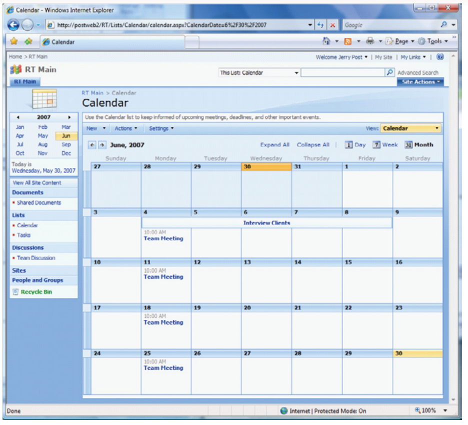
Figure 8.15

Discussion. You can create multiple discussion threads so all comments on a topic are grouped together. The system maintains the group memory so teammates can check on the reasons for various decisions.

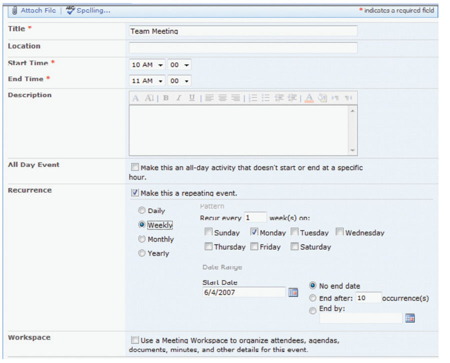
to everyone—generally they are displayed prominently on the first page. Lists can be created to display timetables for tasks, contact names, or any other category needed by the group.

The power of sharing lists through a Web site is that members of the team can see the lists at any time. As authorized members make changes, everyone has access to the current data. Moreover, the lists can be organized and searched by various categories, such as deadline, project sponsor, or participant. Some standard lists exist in SharePoint, such as contacts and schedules. Additional lists can be created at any time. SharePoint also maintains e-mail contact lists for teammates and for any other core contacts that you need to share. This address book is easily accessible by everyone, and a single click launches your e-mail editor. If you need more powerful communication capabilities, including the ability to conduct online meetings, you will want to add the Microsoft Communicator server. If you have a messenger service (e.g., Live Messenger or Communicator) installed on your computer, while you are logged into the SharePoint system, it will show you a list of other team members and tell you if they are online. You can click on the name for each person online and send a quick message.

As shown in Figure 8.15, SharePoint includes a discussion system. It runs within the standard system without relying on external tools such as Communicator.



Event Calendar



Recurring Event

Figure 8.16

Project events. The internal calendar integrates with the event list. You can create tasks and assign them to team members. Recurring events are useful for regularly scheduled meetings.

Most people are familiar with Web-based discussion groups. Discussion administrators establish topics and can specify the roles of the other team members, such as the ability to read or reply to comments. Discussion groups are useful on team projects to discuss issues that arise. The strength of the computer-assisted discussion is that everyone has access to the comments, and the entire record is available if questions arise later. It also makes it easy to search for specific problems. Discussions can be created on any topic. Common business uses include overall comments on scheduling, sharing research information, and discussing problems that arise. You can also attach a Word document or spreadsheet to the original message. Team members can make changes to the document and write comments in the discussion list to explain the changes. However, the attachments can be a little difficult to find, so use this approach when you want to emphasize the discussion, not the document.

As shown in Figure 8.16, SharePoint also maintains a calendar that is tied to the task list. You can use the calendar as a simple project management system. The calendar shows scheduled events. You can define recurring events such as regularly-scheduled meetings that always meet at a certain time. The process of creating events is similar to that used in Microsoft Outlook. In fact, you can integrate the SharePoint calendar with your Outlook calendar. You might want to download the SharePoint events onto a laptop so you can check the calendar while you travel.

The calendar is also tied to a task list that makes it easy to assign and monitor tasks by employees. By scheduling tasks and assigning them to various workers, you can easily see which tasks are on schedule and which are falling behind. You can use the calendar and the task completion list to see if some employees need additional help. The system does not offer all of the features of a true project management system, but it displays the basic schedules and is easy to use.

Surveys are useful for some business applications. In particular, they come in handy when designing new systems. Generally they are used to obtain a quick

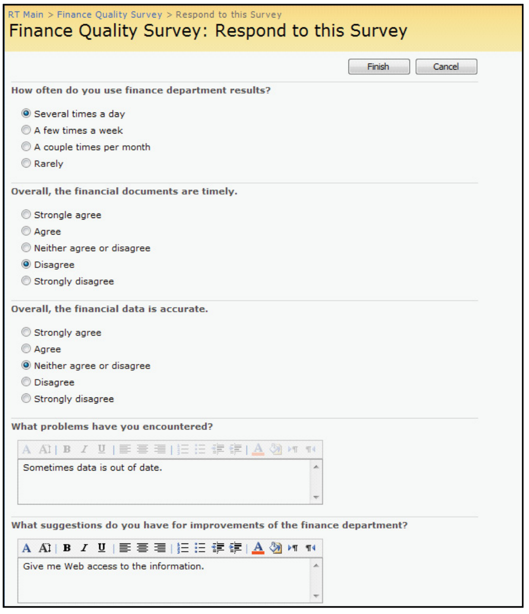


Figure 8.17

Create a survey. You add individual questions to the survey. They can have a variety of formats. After filling in the template for each question, users can enter data over the Web, and you can instantly see the responses on another Web page.

perspective on individual opinions. Paper surveys are a pain. Web-based surveys are easy to change, easy to fill out, and can instantly report the data. As shown in Figure 8.17, SharePoint includes a basic survey-building tool. You simply write the questions by selecting a format, entering the question, and identifying the possible responses. When you post the survey to the SharePoint site, the other members of the team enter their selections. The results are immediately available. One advantage of the system is that the entire process is done through Web forms. Note that the surveys are not available to people unless they are registered in the group, so the technique does not work as well for public surveys. However, SharePoint does support anonymous access, and the configuration system includes templates for building Web sites. So you could use a SharePoint site to interact with public responses, but it takes some effort to configure. On the other hand, professional survey design software is relatively inexpensive and has more features for creating and analyzing surveys.

Collaboration

Until recently, most organizations shared files through shared directories on LANs or via e-mail. Document libraries are simply Web-based folders that hold a related collection of documents—such as all work on a particular project. The files are accessed across the Web, so they are accessible to team members anywhere in the world. Furthermore, the group leader can establish a template so that all documents have the same look.

As shown in Figure 8.18, once the site is set up, accessing the documents is easy—through the familiar File and Open commands. Generally, you will create a

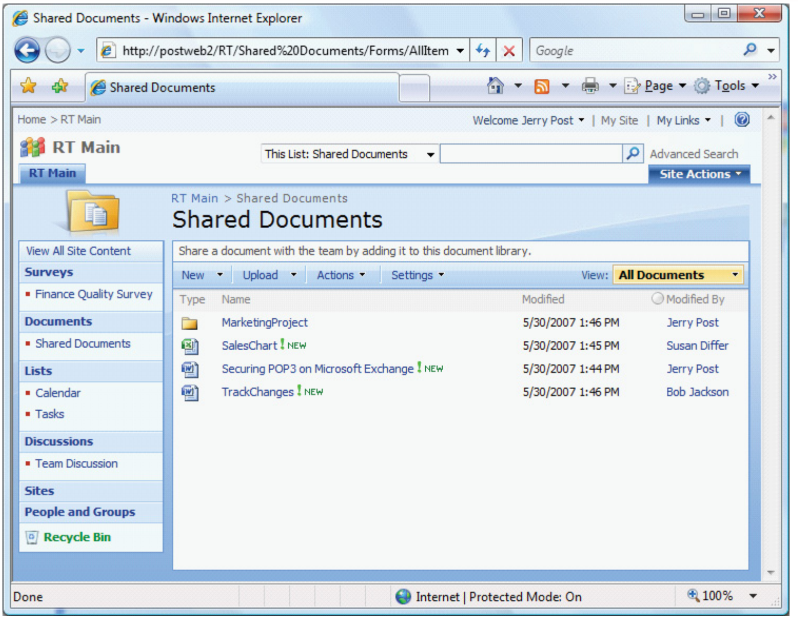


Figure 8.18

Shared documents. You can use the upload link to transfer a file to the server for sharing. You can also use the New Document link to add a Word document directly to the folder. You can open and save any existing document directly over the Web.

link to the directory in "My Network Places" so that you can find the documents with one click. In a team environment, it is important to store your files in a document library—instead of on your personal machine. That way, everyone in the group can read and contribute to the work. Once the documents are stored in the shared library, some other powerful tools and options can be used to coordinate the team, as described in the next sections. Note that direct access to the documents generally requires that each team member have the most recent version of Office installed. You will usually want to protect the document and track changes so that everyone can see the changes that were made by others.

SharePoint can also handle version control. Moreover, version control systems support check in and check out of documents, so that only one person can edit a document at a time—minimizing the problem of needing to determine which change to keep. It also tracks who made the changes and which team member is currently using the document. If you want complete version control including the ability to automatically track changes, you will also need Visual Source Safe, Microsoft's version control software. As shown in Figure 8.19, you configure version control by setting the properties for the document library. You access the configuration options within the document library: Settings/Document Library Settings/General Settings/Versioning Settings. Other options enable you to specify a default template for new documents to encourage teammates to apply a consistent style so documents look the same. Furthermore, you can require that documents be approved by the owner of the group site before they are made available to everyone.

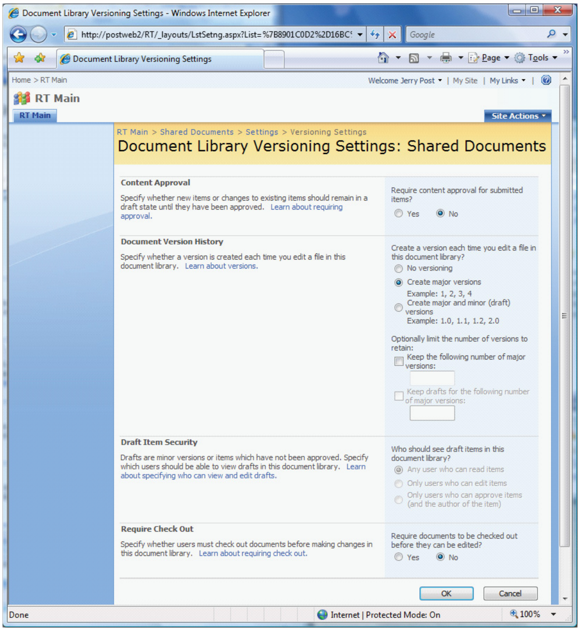


Figure 8.19

Configure library options. Use the server options to set up version control. Additional options are used to specify default templates so all contributed documents follow a standard style. You can require that files be approved before they are made available to the team.

Once version control is configured, the process is automatic. When a team member edits and saves a document, SharePoint automatically creates a new version. From the document library, you can choose the drop-down action list to select versioning. As shown in Figure 8.20, you will see a list of the versions along with dates and optional comments. From this version list, you can open prior versions to copy desired sections. Or you can delete an entire version, including the latest—causing the system to revert to the prior version. However, in general, you should avoid deleting versions—you never know when the changes or data might be useful. Instead, simply copy the older version, make the desired changes, and save it as the new version.

Sharing documents presents additional problems, particularly **concurrent changes**. What happens if two people alter a document at the same time? When the versions are saved, which changes should be kept? One solution to this problem is to use Check-out/Check-in to lock the document. When you check out a document, no one else will be able to edit it until you make your changes and check it back in. If you plan to make major changes to a document and need to ensure that no one else alters it until you are finished, you should use the check-out option. Other users will be notified that you have the document open and will be allowed to read it but not make any changes.

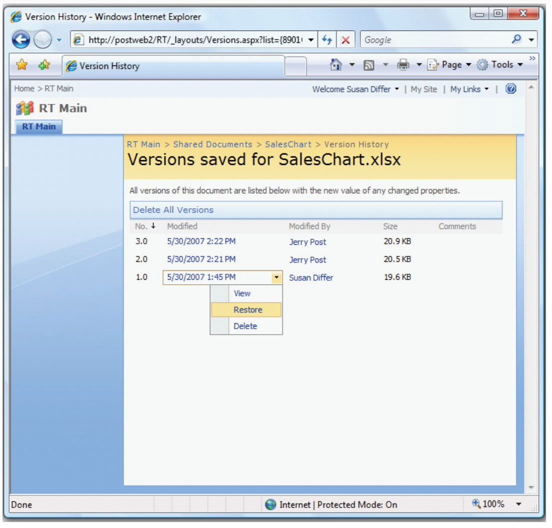


Figure 8.20

Version control. Choosing the version option from the document library screen shows you the prior versions, who edited them, and the comments that were added. You can open prior versions to copy sections or simply revert to the prior version.

Workflow

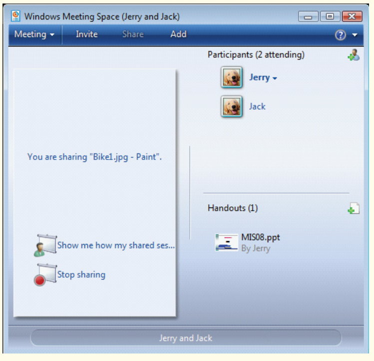
Although it is not as sophisticated as specialized business process management systems, SharePoint provides a couple of tools to help with workflow. These tools integrate the features of communication and collaboration. Routing documents and messages is a useful workflow tool. For example, your manager probably wants to review recommendations that you make, purchasing managers are responsible for approving the purchase of major items, and important documents have to be approved by the legal department. Projects tend to have discrete steps. Sometimes the steps are as simple as obtaining an approval and comments from someone before proceeding.

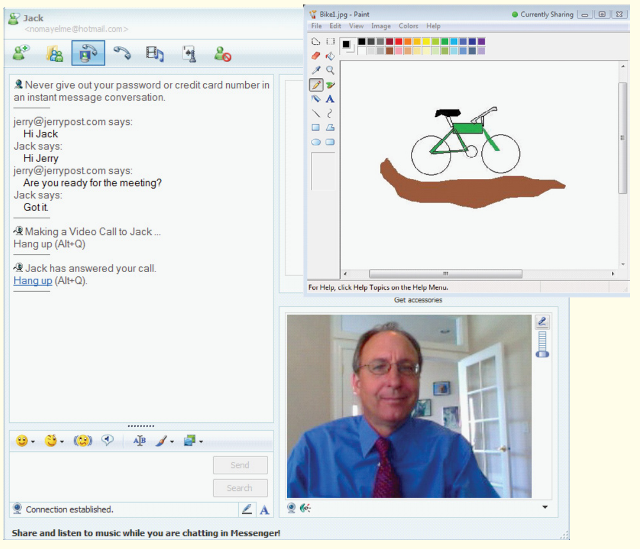
As shown in Figure 8.21, it is straightforward to establish a workflow process in SharePoint. Simply select the document from the library and choose the Workflow option. In this case, workflow means that the document and your message will be e-mailed to a list of team members in order. The actions offered to each person depend on the type of workflow that you choose. The two main types are shown in the figure. To access the other two, you need to change the site properties. The four types are: (1) Approval, (2) Collect Feedback, (3) Collect Signatures, and (4) Disposition Approval. The Approval method sends the document to each person and gives them options to (a) approve, (b) reject, (c) forward the message to someone else to handle the approval, or (d) request changes. If one of the recipients rejects the document, the process is interrupted and it is returned to the sender. The Feedback option asks each person to enter comments. When the last person has responded, all comments are returned to the originator. Collecting signatures requires that the company have a digital signature system in place, and it is integrated into and requires the use of Office software (such as Word), not just

Technology Toolbox: Meeting Space and IM

Problem: How can you meet with a few people online to discuss a document?

Tools: Several online meeting systems have been created to help you conduct a meeting for a small group. Microsoft Meeting Space is a free tool that is built into Windows Vista. You will also want to use Instant Messenger (IM) or Communicator. More sophisticated systems are available as stand-alone packages or as Web services, but they can be expensive. IM and Communicator support both voice and video connections as long as you have microphones and webcams.





The easiest way to start a meeting is to find the participants and connect through IM first. Otherwise, you can start a meeting and e-mail them an invitation. IM needs to be configured by each person with an e-mail account. Microsoft servers help users find each other. Use Communicator if you need more privacy and security.

Setting up a meeting is as easy as having the host start Meeting Space, and enter a meeting title and password. If the IM connections have already been made, simply click the user's name in the display list. Otherwise, click the link to invite people and follow the instructions to save and e-mail the invitation file.

Once the meeting connections have been established, you can start a program and click the Share option so that others can work on the document or drawing. Everyone sees the changes, but only one person has control at a time. The file and the software remain on the computer of the person who shared it so it works even if only one person has the software installed.

You can also share documents or PowerPoint files as notes. Everyone can see them, but only one person can change them at a time. Remember that you need relatively fast connections (upstream and down) to transfer voice and video. If the connection becomes overloaded, you can stop the video transmission or switch to telephones.

Quick Quiz:

1. What problems are you likely to encounter if more than four or five participants try to use online meeting software?
2. Why is voice communication important in an online meeting?
3. Is a video connection critical to online meetings?

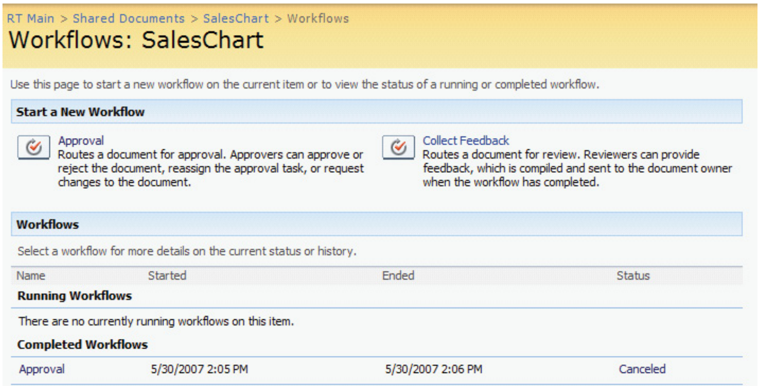


Figure 8.21

Workflow. SharePoint supports basic workflow options that will cause documents to be e-mailed sequentially to a list of team members. The four primary options are: approval, collect feedback, collect signatures, and disposition approval.

the Web browser. The Disposition option is a request sent to a list of people asking if expired content can be deleted.

More complicated workflow rules can be created with InfoPath and Microsoft Project. All of these tools integrate with some minor programming. For example, a list can be created to describe the state of a document (draft, approved, final). Then various conditions and triggers can be applied to specify conditions for each state and how the document must be handled. For instance, two specific people must approve a document before it can leave the draft state and move to the next steps. Or, a document must have three completed and approved figures before it is considered to be complete. These rules require some effort to set up, but once established, the system enforces the basic procedures of the business. Moreover, team members can check on the progress of a project to see what steps remain, or identify which team member is holding up a particular document.

Another powerful workflow technique is to add alerts to the shared items. As shown in Figure 8.22, you can set an alert so that you are notified when a document is changed. For example, you might need to obtain your supervisor's approval before continuing with a document. Save the document in the shared folder, notify the person that it is available, and then attach an alert to the document. When the document is revised, you will be notified by e-mail automatically. You can avoid bothering your manager, or wondering if he or she has gotten to the document yet. Note that you should inform everyone about these capabilities, partly so that they can take advantage of them, but also to minimize privacy issues. You can attach an alert to almost any object in SharePoint, including discussions.

SharePoint Configuration

Because SharePoint has so many options, it takes some time to learn to use SharePoint effectively. Once a site is configured, the basic options are generally accessible through tabs or drop-down menus. Figure 8.23 shows some of the options configured for this particular site. Many of the options can be added or removed by editing the site properties. Additional templates provide other functionality. For example, the Site Directory template indexes all of the subsites and workspaces so

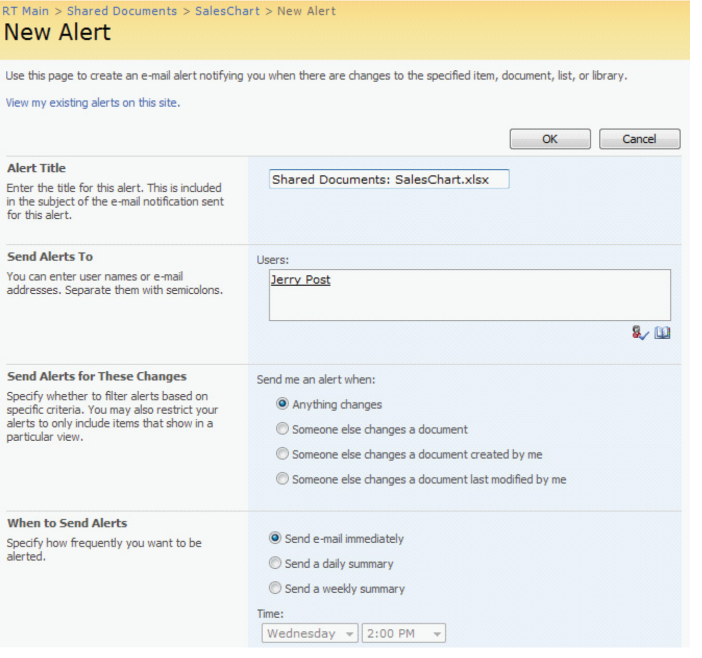
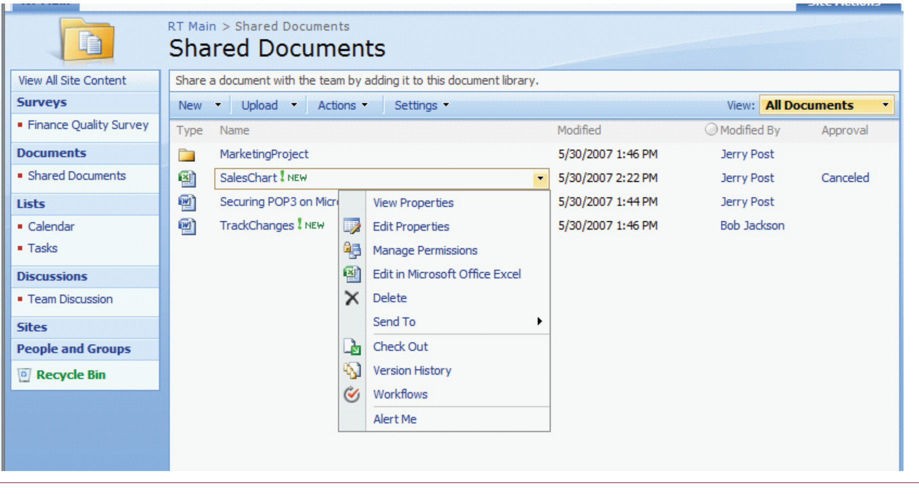


Figure 8.22

Change alert. Almost all shared documents and lists support alerts. Whenever a document or folder is altered, an e-mail message will be sent to you. You can use alerts to track the progress of documents as they are revised by various people.

Figure 8.23

Document options. As you customize the site, additional options and actions become available in the tabs and drop-down menus. Users should explore the various options to understand the power and value of each choice.



Reality Bytes: Teamwork Tools

Several online tools have arisen to help people work as groups. Many people are familiar with the basic file-sharing tools of Google and Microsoft. But more advanced tools exist to support brainstorming, editing, and reviewing.

Tool	Site
Associations/Brainstorming	
Mind Maps	www.mindmapping.com
Bubbl	www.bubbl.us
Mind Meister	www.mindmeister.com
Spinscape	www.spinscape.com
Shared Workspaces and Drawing	
Show Document	www.showdocument.com
Twiddla	www.twiddla.com
Document Creation and Review	
Writeboard	www.writeboard.com
Google Docs	docs.google.com
Zoho	www.zoho.com
Microsoft 365	www.microsoft.com/en-us/office365/ online-software.aspx
Review Basics	wwww.reviewbasics.com
Web Site Creation	
Wikidot	www.wikidot.com
Wikispaces	www.wikispaces.com
Project Planning	
Wrike	www.wrike.com
WizeHive	www.wizehive.com
Basecamp	www.basecamp.com
Meetings	
Adobe	https://acrobat.com/welcome.html
Microsoft Live Meeting	www.livemeetingplace.com
Cisco Webex	www.webex.com
Go to Meeting	www.gotomeeting.com
Log Me In	www.logmein.com

Adapted from Logan Kugler, "Online Collaboration on the Cheap: 20 Free and Low-Cost Tools," *Computerworld*, June 3, 2010.

users can select sites by hierarchy, department, or through a search. You also use the site properties to control security and access permissions.

It is also possible to substantially alter a SharePoint site. In addition to basic templates and color schemes, you can use the SharePoint Designer to integrate additional functionality into any site and to develop new templates and options. SharePoint is built on top of Microsoft ASP .NET, which is a substantial Web server programming language. Using Visual Studio, programmers can develop custom modules and integrate them into SharePoint, or retrieve SharePoint data and perform analyses. The process requires a trained programmer, but it means that almost any type of configuration is possible. For example, you can use forms-based authentication to enable external business partners to contribute to your SharePoint site. SharePoint also provides Web Parts that are modules to integrate some specific complex actions into SharePoint. For example, the Excel Web Part uses SharePoint (.NET) code to programmatically build new Excel worksheets. Users can enter data on forms and your code can transfer that data to a custom worksheet, which can then be added to a document library. These techniques will take time to develop, but they can be used to automate relatively complex tasks.

Peer-to-Peer Collaboration

What if you do not have a server and want to collaborate? SharePoint has many powerful features, but it requires setting up a special server to hold the documents and handle the Web communications. Similarly, the open-source collaboration tools rely on setting up an account with a third-party Web site and adding everyone as users. A central server has some significant strengths; such as version control, automatic backup, searches, and being easy to find. However, sometimes you do not need that much power, and do not want to spend the money and time creating a central system. Also, you might want to use a tool that supports immediate interaction—where everyone can make changes and work on a document simultaneously. However, remember that in any peer-to-peer situation, you are constrained by the limitations of NAT. If a person you want to connect with is outside of your local network, you will need a server at least to find the other computer and establish the connection. Microsoft has released several specialty servers (Communicator Server, One Note Server, and so on), specifically designed to create these connections. If your company does not run these servers, you will need to pay a third-party (e.g., Skype or Microsoft Live) to establish the connection.

Sharing Documents

You can always resort to using e-mail (or USB drives) to share documents if you do not have access to a server. But sometimes you want to share files directly. As shown in Figure 8.24, Microsoft provides a second sharing tool that has features similar to those in SharePoint server. Confusingly, in 2010, the tool was renamed as SharePoint Workspace. The main sharing session is still named Groove. All participants need a copy of SharePoint Workspace installed on their computers. Participants also need to be able to connect their computers. If everyone on the team works for the same company, you should be able to select people from the company network. Otherwise, you will need a server to coordinate users across networks.

The system works by creating a shared workspace on each computer. A computer can handle multiple workspaces—for different projects or teams, but creat-

Figure 8.24

Microsoft Groove. Groove creates workspaces on each team member's computer. The files are replicated onto each machine and synchronized when the computers are connected. Groove also supports discussions, alerts, calendars, and meeting notes.

ing too many will slow down communications. One user initiates a new workspace and invites other people to participate in the session. At that point, Groove creates a folder on each of the machines to store shared documents. Any document created on one computer is **replicated** to the folders on all of the other machines. Users who are traveling and not connected to the network can still work on all of the files. When the computer is reconnected to the network files on all machines are **synchronized** by exchanging all of the changed data. Similar to SharePoint, Groove also supports shared calendars, a discussion system, and a meeting tool. It also provides alerts to notify you when a file has been changed. Groove lacks some features, such as version control. However, it includes a SharePoint Files tool that makes it easy to publish the documents to a SharePoint document library. One possibility is to use Groove to work on preliminary versions of documents with a few people on your team, and then publish major versions to the SharePoint server to make them available to a larger team.

Groove also supports several tools for direct communication. For example, it contains a discussion tool that tracks comments and replies. A shared calendar can store tasks and meeting dates. More interestingly, Groove supports an interactive notepad and sketchpad. These tools are shared in real time with participants who are currently connected. For example, with the sketchpad, multiple people can be drawing items at the same time—and all changes will be displayed on everyone's screen.

If you are familiar with the Microsoft One Note application, you should know that it also supports a couple versions of sharing. One Note is a unique application that is designed to provide features similar to a paper notebook. You can

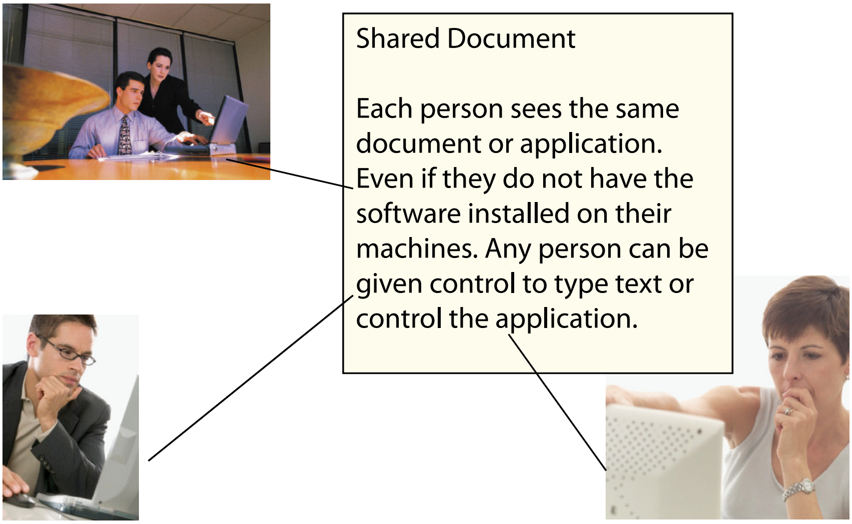


Figure 8.25

Meeting Space. The host starts a meeting and invites others to join. The host starts an application on his computer and shares it with the others. Everyone sees the same document and can be given control to make changes and run the application.

create notes by typing, using a pen on a tablet PC, drawing or importing figures, adding almost any type of file or Web site, or adding audio or video notes. You create pages on which you can put almost any content, and then you organize the pages to make them useful. One Note also makes it easy for you to search your typewritten notes. The Shared Notebook feature makes it relatively easy to share a collection of pages with team members. The key step is that you must create a master copy and place it on a folder that is accessible to all team members. They can download and work on the notebook, and their changes will be synchronized with the master copy. If you have a small office, you can use a shared folder on a desktop to hold the master copy. In larger companies, you should consider using SharePoint to hold the master copy. It is easier for users to find the documents and SharePoint maintains version control.

Immediate Interaction: Microsoft SharedView

Immediate interaction is a second type of peer-to-peer sharing that is more exciting. Simple communication tools, such as instant messenger, count in this category, but more powerful tools exist. For example, Microsoft SharePoint Workspace supports live connections for notepad and sketchpad. Microsoft One Note also supports Live Sharing. Another Microsoft product for interaction is SharedView, which can be downloaded for free. All of these tools enable multiple people to connect to a computer and work on a document at the same time. Changes made by one person are immediately displayed on everyone's computer. Of course, it can get confusing if everyone tries to type or draw at exactly the same time, so people usually take turns. The point is that everyone can see the changes immediately. This process makes it easier to spot mistakes, find new directions, or solidify ideas.

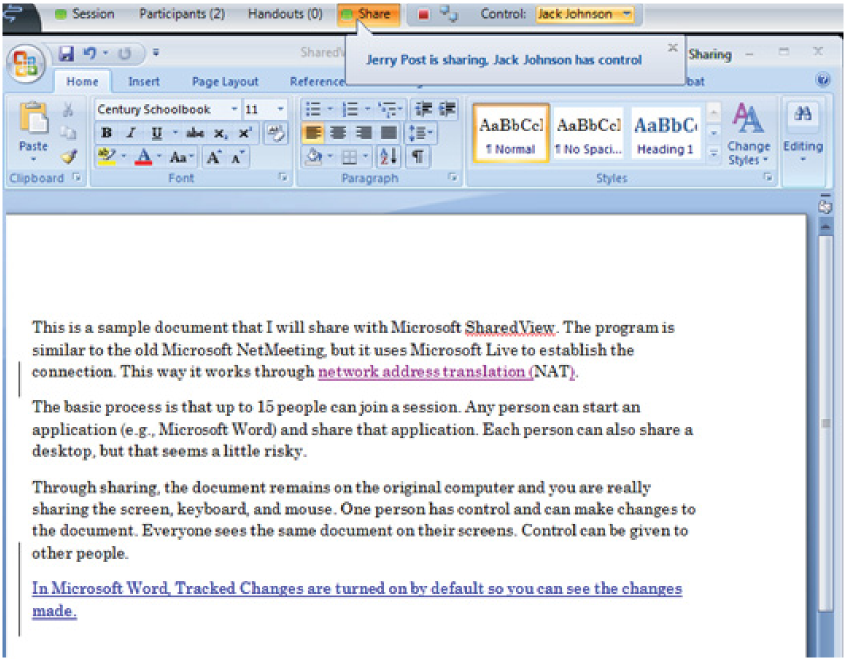


Figure 8.26

Microsoft SharedView. Up to 15 people can work on a single copy of a document, application, or desktop. Only one copy exists, but everyone sees the same screen. You are sharing the screen, keyboard, and mouse.

These tools work the same way, so this discussion will focus on SharedView because it is free and is relatively powerful. When you use these tools, you will also probably want to make a connection with a voice or video communication tool such as Messenger or Skype so that you can talk to the other people while you are making changes.

As shown in Figure 8.25, once the computers are connected through the meeting software, you can share applications, or even your desktop. As a host, you start SharedView and log in. Then you start a new session, which generates a session name and password. The tool also creates a simple invitation with a link to your session that you can e-mail to other people. The link routes them through Microsoft's SharedView server to make the connection.

The entire purpose of SharedView is to enable multiple people to work on the same document at the same time. The nice part is that you can share any application—even if it is not installed on the other computers. You can even share the desktop, so someone else can run your entire computer. Okay, that choice is a little scary, so be careful who you grant permission to run your desktop. It is useful if your project involves multiple applications or if you need help from an expert. Try sharing a drawing application such as Word, PowerPoint, or Paint. Figure 8.26 shows a simple example using Microsoft Word. Note that track changes is enabled to make it easier to see what changes are being made. Each person can draw, add text, or bring in images or other files. Everyone gets to see the changes as they are made. Remember that there is only one copy of the document—the file is stored

Figure 8.27

Microsoft Surface. Multi-touch screens create a new interface for interacting with objects on the screen. They also enable several people to work on objects at the same time. (Photo courtesy of Microsoft).

on the hosting computer. The other computers are working with a simple screen copy. You can always e-mail the final file to everyone. SharedView also lets you share any saved file as a handout which can be retrieved immediately by the other participants.

SharedView works with a relatively small number of people, but if you get too many people working at the same time everyone will interfere with each other. However, note that the system limits control to one person at a time. The person in control has the ability to make changes to the document. The host can select who is in control, but everyone sees the resulting changes. This tool can actually be useful even if everyone is in the same room. Although only one person can enter text or make changes at one time, it is easy to switch among the participants to let people take turns.

Sharing with Multi-Touch Panels

What could you accomplish if five people work on the same screen at the same time? Several companies are developing computers that use an entirely new form of interaction. It is known as a multi-touch panel. Essentially, several video cameras beneath the display observe touches and gestures by multiple fingers, which includes multiple people, at the same time. Professor Jeff Han astounded people with his presentation in February 2006 at an annual technology conference. Search for it on YouTube. The applications were mainly graphical and geographical, but the ideas offer profoundly new ways of interacting with the computer. Basically, users touch the screen and manipulate objects using various motions. From a team perspective, the interesting part is that several people can work on the same display at the same time. As shown in Figure 8.27, in 2007, Microsoft announced a coffee-table-size computer called Surface based on a similar technology. Essentially, users can sit around the display table, and work on a project together. The system can even recognize (some) objects when they are placed onto the display table. The technology might remain expensive for a few years, because it requires fast computation speeds to make it look good. Other vendors, such as PQ Labs, are now offering glass overlays that can be attached to a standard large panel LCD monitor to enable multi-touch interaction.

Because the technology is new, few people have had the opportunity to work with it. The bad news is that it will take a few years to develop good business and data applications. The good news is that you could invent a new way of having people work together, build the system, and sell it for tons of money. The initial applications are likely to be graphically oriented, because they are easier for people to understand and to have several people contribute at the same time. But, the basic groupware tools described in this chapter could be modified to work with this hardware. People could work on different elements at the same time. For example, one person could work on financial data in a spreadsheet while another works on a presentation slide. Data from the spreadsheet could be dragged over to the presentation when it is complete. Or, perhaps two people could search for information at the same time and combine the results to do a quick comparison.

One drawback that will slow the development of software is that all of the operating systems (Windows) are built to work with only one mouse and one keyboard at a time. The application focus controls where typed data is entered, and Windows and other applications currently support only a single focus point. Eventually, this limitation can be overcome, but it will take time for developers to change the old applications.

File Formats and Standards

How do you collaborate and share data if everyone uses different software? To put it another way, why is this chapter so reliant on Microsoft technologies? The answer to the second question largely comes down to the fact that Microsoft Office has about a 95 percent market share (Business Week, July 3, 2006) and at least 80 percent in businesses (Forrester, 2009: http://www.networkworld.com/news/2009/060409-forrester-microsoft-office-in-no.html). The underlying issue is that if you want to share documents, everyone needs to be able to read the files. Microsoft has largely relied on proprietary file formats. Even though some programs exist to convert files into other formats, the conversions are never perfect; and they are likely to lose the sharing properties in the process. To collaborate with shared documents, all participants need to be able to read and write the files in the exact same format. Historically, this compatibility could be accomplished only if everyone used the same software—and even the same versions.

When programmers develop software, they need to design a way to store the associated data. Historically, most companies have developed proprietary binary file formats that are optimized for their specific purposes. Proprietary formats had the side benefit of encouraging everyone to adopt the same software to avoid the conversion hassles. The problem of transferring binary files is bad enough when everyone uses the same basic hardware. Binary files store data in the underlying format of the processor on which they were created. These formats vary for different types of computer processors. The World Wide Web was actually designed to solve this particular problem. Physicists wanted a way to share their research, so

Reality Bytes: How Do Workers Communicate?

In 2009, Forrester Research conducted a study of 2,001 American workers at medium-to-large organizations in terms of their technology usage. The results showed that several predicted trends have not yet taken root in mainstream corporations. Only one-third used laptops for work and one in nine had a smartphone. Almost 20 percent shared a PC with a coworker. In terms of communication, e-mail was the most frequently used method—with 60 percent of the workers saying they checked e-mail at least hourly. Almost three-fourths said they never use instant messaging at work. Most could simply talk to coworkers or use the phone. Many people blamed lack of IT support for newer tools. Around 70 to 80 percent of the workers never use groupware tools, including Web conferencing, Microsoft SharePoint, social networking, or videoconferencing. Of those who did use these types of systems, less than 20 percent said they were "experts" and about the same number said they were "very satisfied" with the tools. At the same time, 45 percent of them said they spend three or more hours a week looking for important information.

Adapted from Eric Lai, "8 Ways the American Information Worker Remains a Luddite," *Computerworld*, October 12, 2009.

Web pages are defined as simple text files that can be read by any type of computer, along with the markup language (HTML) to display pages consistently. However, HTML is not powerful enough to handle complex documents, so the world is still searching for a method to share word processing documents.

The International Organization for Standardization (ISO) approved the Open Document Format (ODF) in 2006 as a world-wide standard for storing common office documents. Conceivably, if enough vendors adopt this format, it will be easier for competitors to offer new tools, particularly collaboration tools, that work with documents created from any software. Support for most of the ODF standard is built into Microsoft Office (use File/Save As and pick the Open… format). But these formats simply enable people to read documents with other software. Standardized support for collaboration notes and security are weak. Microsoft has made its file formats more accessible, but it is not clear that other companies will adopt the features.

Cloud-Based Collaboration

Another way to share documents and collaborate is to use one of the online browser-based systems. As browsers gain more power, it has become possible to create relatively complex applications that run on the browsers alone and store the data on a Web server. The two leading sites are Google Docs and Microsoft Live. Both offer free access with a limited amount of storage or you can purchase accounts with more storage capacity and other options. For example, Google Docs offers business accounts for $50 per person per year. These accounts could be used by one person to create common documents (word processing, spreadsheet, or slide show). However, the real strength comes with the fact that the documents are on a cloud server. With the documents in a central location, multiple people can access them. By relying on Web browsers, it is not necessary for users to install software, and the files can be reached using almost any device from anywhere in the world.

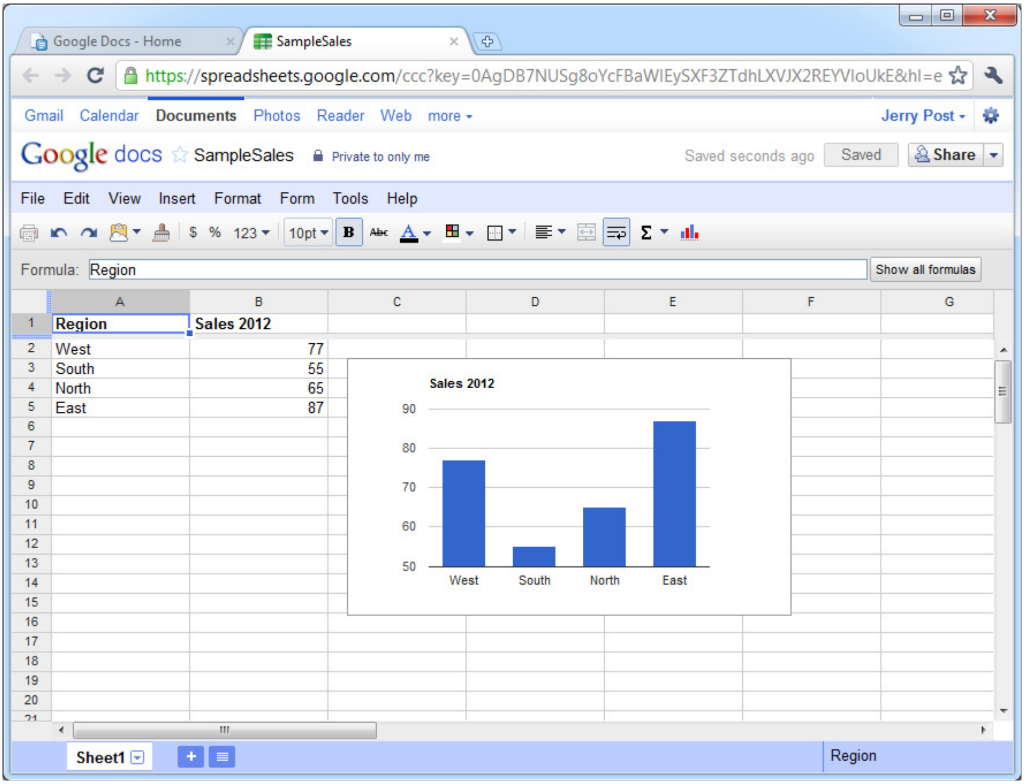


Figure 8.28

Spreadsheet in Google Docs. Spreadsheets and documents support standard features including layout, functions, and charts. Usability and features are somewhat limited because of the reliance on browser capabilities but it is easy to share access to the documents.

Figure 8.28 shows an example of a simple spreadsheet created in Google Docs. The tools provide basic functionality and are built using commands you are already familiar with. The Google system relies on menu commands, which you can browse to see what features are available. Partly because of limitations with browsers, functionality is somewhat limited compared to the PC-based Office programs. For example, there is no simple copy-and-paste operation to move a chart from a spreadsheet into a document. Instead, it has to be saved as an image file.

On the other hand, sharing a document is straightforward. Choose the Sharing option in the document list and you can make the document private, public, or share it with a specific list of users. You can send a link to the document to people who need to review or edit it. Google also supports up to 50 people editing the same document at the same time (10 for presentations). Changes made by each person are updated and pushed out to the other copies in real time. The names of each collaborator are listed at the top of the page and you can open a chat window to share comments.

Microsoft Live also has a set of online editing tools (www.live.com or www.microsoft.com/live). Live started with a focus on communication tools (Hotmail

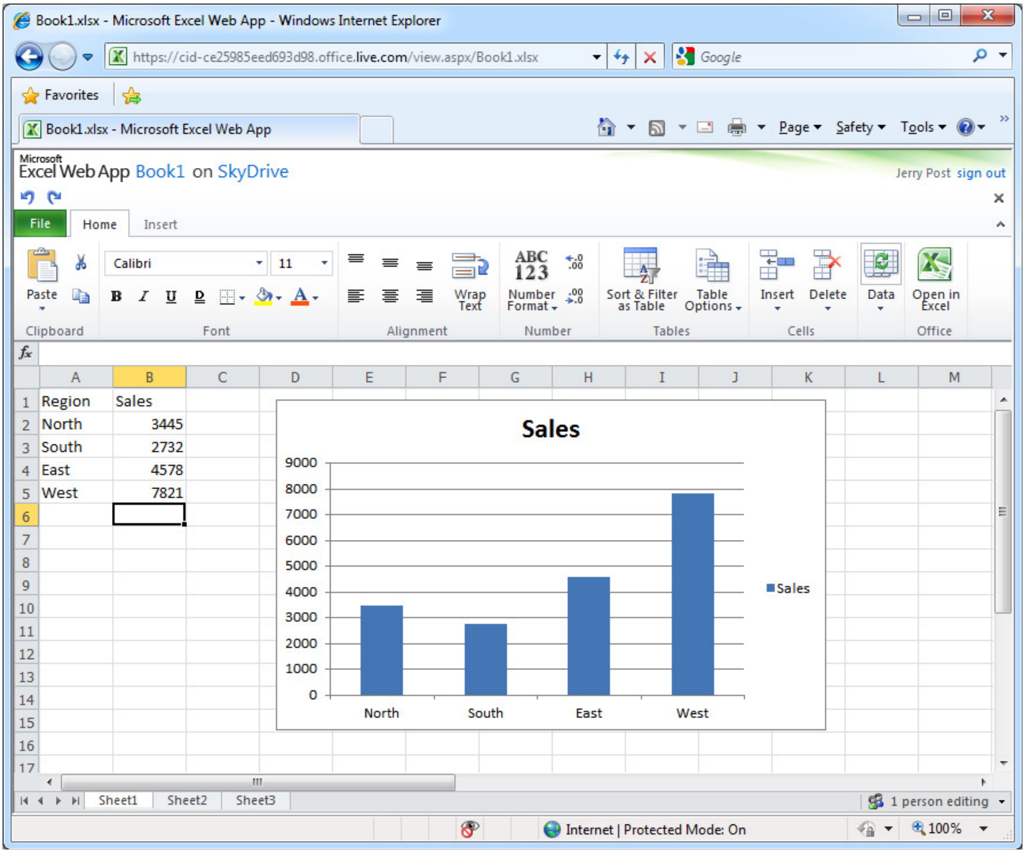


Figure 8.29

Spreadsheet in Office Live. Spreadsheets and documents support standard features and can be downloaded and edited in the PC-based tools. They also can be shared with other users.

and Messenger), so the first page still emphasizes them. Click the Office link to get to the main documents site (office.live.com). Figure 8.29 shows that the tools use a ribbon-based editing system—but there are fewer options than in the PC-based tools. However, there is a button to download the file and edit it with the PC-based software if you are working with a PC that has it installed. So it is easy to move back and forth between your local computer and the server-based copies.

Microsoft Live also makes it straightforward to share the online files with the public or with a select group of friends. The system also keeps versions and automatically saves your work. With the 2010 online version, Microsoft introduced simultaneous editing. Each user must be given edit permissions and open the file (spreadsheet) using the Web browser. Changes made by one person are pushed out and displayed to the other people editing the document. You can test the process with yourself by opening two separate browser windows and editing the same document twice.

The primary features between Google Docs and Office Live are similar, but the Microsoft layout and commands are closer to the PC-based versions so it might be easier to user. However, as a manager, you should be familiar with and have accounts on both systems in case someone wants you to work with a specific set of tools. Both options are useful if you want to carry around a tablet computer. Most of the early tablets do not have the ability to run common PC-based software, but do support standard browsers. If you want to rely on a tablet, you need to use cloud-based computing to create and store files.

Summary

Working together and sharing data are crucial in today's companies. MIS can help teams work better with tools designed to integrate data across an organization. Managers need to know how to use a variety of tools, from data sharing over networks, to dynamic linking, to groupware products.

Teamwork begins with communication, and information technology provides many ways to communicate, from voice mail, e-mail, text messaging, Web pages, and blogs, to videoconferencing. As a communicator, one of your challenges is to choose the appropriate communication channel for the specific type of message. Teamwork also requires scheduling and task coordination. Electronic calendars and project management tools help everyone identify bottlenecks and keep projects on schedule. Meetings take big blocks of time from all managers, but they are often critical to communication and the success of a project. Electronic meeting systems make it possible to meet regardless of location. They also provide records of the meetings that can be reviewed or searched later.

Collaboration requires sharing documents and knowledge. Shared document features enable you to track changes made by all teammates. They also provide version control so you can recover elements deleted from earlier versions. Workflow software helps you control the sequence of events and when people will receive each document. Information rights management provides tools to limit the distribution of documents and control what people are allowed to do with each document. Ultimately, an important goal of teamwork systems is to collect all of the information used to make decisions and hold it as the organization's memory. This knowledge management system can then be used for future decisions and problem solving.

Microsoft SharePoint and Groove provide several tools to integrate the elements of the Office suite as well as provide communication and collaboration tools. SharePoint makes it easy to share documents across the Web. It also maintains contact lists, events, and task items. All of the features are shared with teammates. Discussions can be created quickly on general topics or on specific documents. Surveys can record votes on critical issues. When you need more interactive tools, you can add communication and meeting tools as well as tools such as SharedView that enable multiple people to work on documents at the same time.

Cloud-based tools including Google Docs and Microsoft Live make it easy to share documents with multiple people—using only Web browsers. The tools work for basic documents, spreadsheets, and presentations. The cloud servers make the files accessible to almost anyone and maintain backups and even version control. Both tools also support simultaneous editing of documents so multiple people can make changes at the same time.

A Manager's View

Teamwork is an increasingly important aspect of management. Integration of business units so they work together is another important issue. Effectively managed, the techniques can cut costs, improve quality, and improve response time. Communication and collaboration are key elements to the success of any team. Groupware tools support messaging and sharing documents. Business process management tools help automate collaborative processes by adding triggers and rules. Ultimately, storing all information on decisions contributes to the organizational memory, and the knowledge management system can help the company make better decisions.

Key Words

business process management (BPM)
check in
check out
concurrent changes
full duplex
group decision support system (GDSS)
Groupware
Information rights management (IRM)
knowledge management (KM)
protect document
replicated
synchronized
telepresence
track changes
Version control
Videoconference
Workflow

Web Site References

Teamwork Tools	
Microsoft Live Meeting	www.microsoft.com/livemeeting
Webex (Cisco meeting)	www.webex.com
Version control comparison	better-scm.berlios.de/comparison/comparison.html
Microsoft SharePoint	www.microsoft.com/sharepoint
Knowledge Management	
KMWorld	www.kmworld.com
Knowledge Board	www.knowledgeboard.com
KMNews	www.kmnews.com
KMResource	www.kmresource.com

Review Questions

1. What communication channels are available to teams? What are the strengths and weaknesses of each method?
2. Do current communication and groupware tools reduce the need for business meetings? Explain.
3. How does network address translation present problems with collaboration? How are these problems solved?
4. Why is it helpful to use collaboration tools when sharing documents instead of just e-mail?
5. Why is version control important to teams?
6. How is information rights management different from typical computer access controls?
7. What is workflow processing and how is it supported by collaboration tools?
8. What are common features of a group decision support system?
9. What features are important in a knowledge management system?
10. What are the major features of Microsoft SharePoint?
11. How does peer-to-peer collaboration differ from Microsoft SharePoint?
12. Why are file formats so important in collaboration?
13. What are the benefits to using cloud servers for collaboration?
14. What benefits would large multi-touch panels provide for small groups?
15. Briefly explain the main capabilities of the following tools:
    a. Microsoft SharePoint server
    b. Microsoft SharePoint workspace/Groove
    c. Microsoft SharedView
    d. Google Docs
    e. WebEx
    f. Skype

Exercises

1. Can smart phones be used for video conferences? Can they be used with phones on other systems (e.g., AT&T v. Verizon)? Why or why not?
2. Research and compare the meeting capabilities and costs of at least two products (e.g., Microsoft Live Meeting, Cisco WebEx, Skype). What types of meetings (e.g., size) is each best suited for.
3. Research the costs of installing several Microsoft collaboration servers, including Communicator, Groove, and SharePoint.

4. For each of the following business situations, identify the collaboration method you would use and briefly explain why.

    a. A salesperson wants to demonstrate a complex software package to a customer group in a different city. The customers can meet in one room.

    b. A corporate vice-president wants to give a two-hour presentation of new products to a local audience of at least 100 people, plus at least 300 company employees in multiple cities, and make it available to authorized reporters.

    c. A design team consisting of a group of four artists and a programmer, each in a different city, need to create a new design for a large Web site.

    d. Students in a club need to write a short document and create a slideshow for an upcoming event.

    e. A group of students and faculty in an investment club need to share data and research with each other and keep records so students can follow the work next year. Outside directors also want to be able to see selected data and reports.

5. Most organizations have a process for submitting and approving a business travel request. If possible, interview someone from a company or the university about the steps involved in creating and processing a travel request. Then describe the steps to create that process in SharePoint server.

6. Describe a business situation in which you would need to implement information rights management controls. Describe the specific rights you would assign.

7. How is Skype similar to but different from Microsoft Messenger?

Technology Toolbox

8. As a team project, if you have access to a SharePoint server, have one person create a small document that describes a computer that he or she might wish to purchase. Set change subscriptions on the document for each team member. Then over the next few days, have members make changes to the document, with suggestions for different components. As team members are notified of changes, they should check the suggestions and either accept or reject them by adding additional comments.

9. Use a SharePoint server to discuss a recent movie. Include links to other review sites and if possible upload image files or movie clips. Create a calendar to assign tasks to each team member. The final result should be a formal review of the movie. Be sure to include your instructor as a team member.

10. With at least two people, choose an industry and assign a firm in the industry to each person. Set up a Groove workspace. Have each person retrieve sales and profit data for the assigned firm. Use the workspace to build a spreadsheet that combines the data from each firm to draw charts displaying revenue and profits for each firm.

11. Set up Windows Meeting Space and create a meeting with at least three people. Together, build a short PowerPoint slide show to come up with a new marketing campaign for an automobile manufacturer (pick one).
12. Compare Meeting Space to One Note/Live Sharing. If you do not have access to the software, use the Microsoft documentation to evaluate the features of the two products. Which tool would you prefer to use for a small team project and why? Test both tools if you have access to them.

Teamwork

13. As a group project, assume that each person in the group is a manager of a different department. Each person creates a spreadsheet to list the salespeople in his or her department (4 to 10), their hours worked, total sales, and commissions. Compute the totals for each column. Once the individual spreadsheets have been created and stored on separate computers, the group will create a composite spreadsheet that brings in the data from each individual spreadsheet. Compute the corporate total and draw pie charts for each column. If possible, use dynamic linking across the network to capture the data from the individual spreadsheets.
14. Using SharePoint, have one person write a short document. Use workflow to send it to each of the other team members for feedback. Submit the final document with the feedback to the instructor.
15. Using Groove, (or SharePoint if Groove is not available) configure a workspace for a project to evaluate cell phones. Use the tools to discuss the features and try to agree on a common cell phone that could be purchased by a company for each of the team members. Hand in the final document and recommendation, with the discussion comments.
16. Using SharedView (with PowerPoint) or SharePoint workspace/Groove to create a listing of the name and major of each person in the group. Create a small diagram as a map that shows your current location compared to the campus library.
17. Connect as many people as possible using a single instant messenger or chat room system. As a topic, discuss a current movie. What problems do you encounter? Should you limit these types of meetings to a certain number of people? What would be the maximum?
18. If your team has to work from home on a project for the entire semester that involves drawings, documents, and discussions or meetings, which tools would you choose and why?

Rolling Thunder Database

19. If you have access to a SharePoint server, set up a team site to discuss production issues. Generate queries to show production delays over time. Put the data into a spreadsheet and graph it. Create a discussion group for the spreadsheet and discuss possible reasons for any issues.

20. (team) If you have the Groove client software, set up a workspace and build a spreadsheet to display and chart U.S. retail sales of bicycles for at least six years. Each person should keep notes on which sites were searched and where data was found. Comment on any differences in data found and produce a best-estimate chart.
21. Describe the hardware and software Rolling Thunder should install so that all employees can coordinate schedules and conduct 15-minute meetings every day.
22. Choose a system that would help Rolling Thunder marketing managers communicate with retail stores to show new designs and products with the goal of reducing the number of physical visits by salespeople.
23. Identify documents that Rolling Thunder should protect with an information rights management system and briefly describe the desired rights.
24. What information would you recommend placing in a knowledge management system for Rolling Thunder Bicycles?
25. Explain how version control would be useful for designing the bicycles at Rolling Thunder. Find software that could provide version control.

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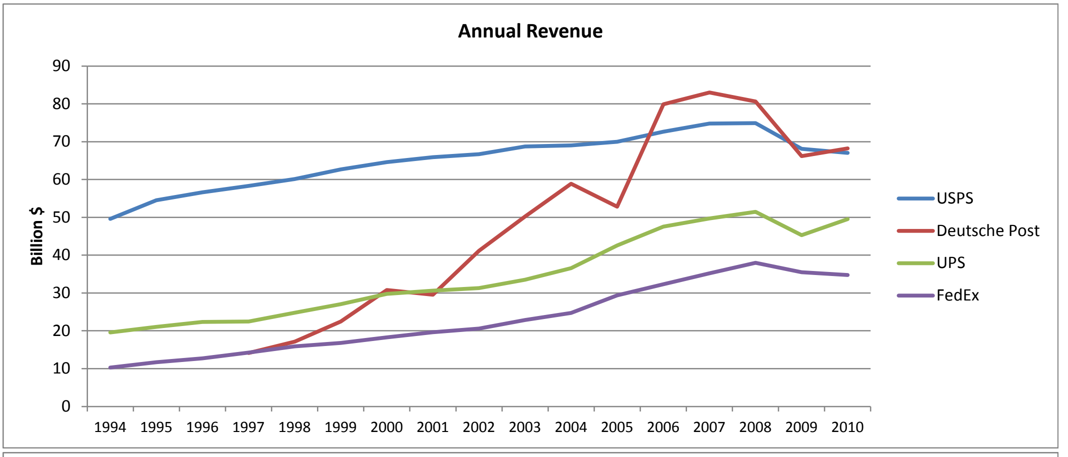
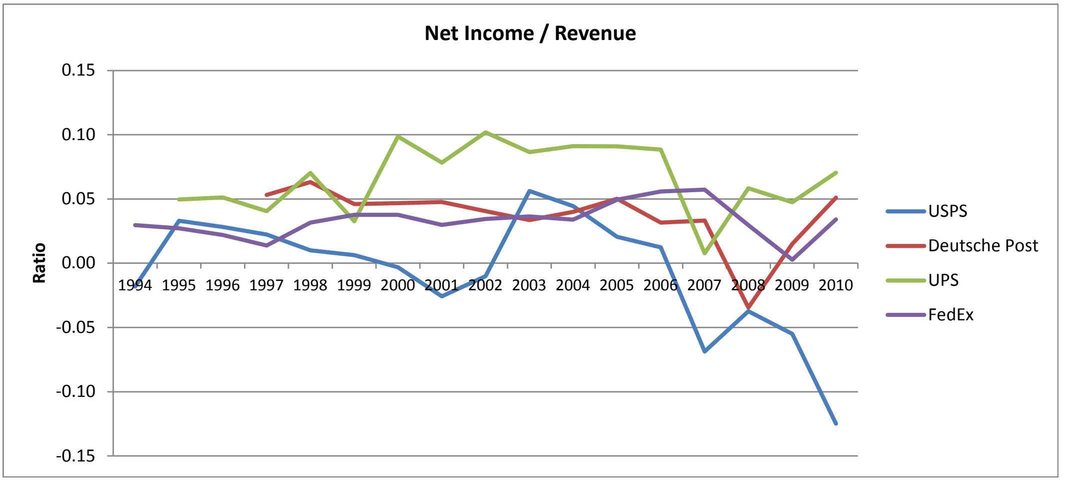
Cases: Package Delivery

The Industry





The package delivery industry has changed dramatically over the past few years. In fact, today, it should probably be called the business logistics industry. Several large mergers have altered the industry. The competition among the remaining firms is intensifying. The primary players today are FedEx Corp., United Parcel Service (UPS), the United States Postal Service (USPS), and Deutsche Post (which owns DHL and Airborne).

To understand the changes, you need to understand how businesses operate today. The most important issue is that large companies operate in many locations, within the United States and around the world. This means that companies need to move supplies, assembled components, and finished products. Parts are moved from suppliers to assembly plants, and finished products are shipped to distribution centers and retail stores. Few firms today want to move their own products on their own trucks—it just does not pay. And smaller firms could never afford to own their own fleets. Instead, the large firms have focused on efficiency, time, and price to be able to provide a complete level of delivery services around the world.

Today, that encompasses everything from freight handling (large shipments) to overnight packages (express delivery).

UPS was at the top of the revenue list in 2003 slightly over $33 billion. DHL was second with $24 billion, closely followed by FedEx Corp. with $22.5 billion (Whiting 2003). However, USPS topped all of them with operating revenue of over $68 billion in 2003; but that includes money from its monopoly position to deliver letters to households (annual reports). The basic rankings had not changed much by 2011 Deutsche Post and USPS had similar sales numbers at the top of the list, followed by UPS and FedEx. Of course, the big difference is that USPS was experiencing billions of dollars a year in losses.

Services and Information

In many ways, UPS was the leader in driving changes in the logistics industry. The company was initially formed to deliver merchandise from manufacturers to retail stores. This third-party service made it possible for manufacturers to increase their sales without having to build their own distribution centers. Even smaller companies now had direct access to sales across the United States. And all companies could use the system to ship short orders in a matter of days.

The industry has changed considerably over time as the firms have introduced new services and combined others. FedEx introduced the concept of next-day delivery. At a time when many people doubted there was demand for such a service, the company owned and then perfected the market. When computers became cheap enough, FedEx introduced package tracking—emphasizing that information was just as important as the package (FedEx Web site) and (Ulfelder 2002). The other carriers struggled to provide the same service, but eventually UPS, USPS, and DHL; as well as a host of other firms moved into next-day shipping. At the same time, FedEx began to move into ground and freight deliveries, shipping larger items across the country and delivering packages to stores and individuals in a few days. FedEx grew largely by acquiring other firms. DHL has an interesting history—largely driven by one man: Larry L. Hillblom, who died in a plane crash in 1995. His focus was air delivery to islands and nations in the South Pacific, and for years, DHL dominated that international market.

Overall, the international market is a challenge for any shipping company, or even any company that wishes to ship packages around the world. Each nation has different customs requirements—in terms of forms, taxes, and even items that are banned. To make it more complex, most nations have their own definitions of items and terms. Complicating it even more, the rules tend to change over time. Now, if you are a manufacturer shipping only a single item to a single nation on a regular basis, you will eventually learn the procedures. But if you want to ship different items to multiple countries, how can you gain the knowledge you need?

Ultimately, the major shipping companies (not including USPS), have created huge online knowledge systems that automate most of the steps in shipping overseas. You simply fill out the declarations properly and their systems produce the necessary forms. UPS and FedEx have special facilities to notify customs agents when packages are arriving and produce detailed information on request. In 2003, the United States Department of Homeland Security (Bureau of Customs and Border Protection) proposed a regulation that all carriers have to notify officials of inbound cargos several hours before they arrive. The notice would have to be electronic so that the bureau could run computerized analyses on shipping data to spot potential terrorist threats or illegal shipments. DHL, UPS, and FedEx generally already meet this requirement. The DHL system is based on Open Harbor's global trade-management system that has over 8 million trade rules (Chabrow and Bacheldor 2003). Ultimately, it is likely that other major nations will require the same advance notice, and all of the carriers and software vendors are building systems to meet these demands. The key point is that shippers now offer much more advanced services. They are not simply ferrying packages—they are taking responsibility for the entire process.

Many companies today use these shipping firms as the first line of their logistics service. Even internal shipments between factories can be handled and tracked by UPS or FedEx. Particularly with the integration of freight, package, and overnight deliveries, companies can flexibly select and monitor their shipments. UPS and FedEx have divisions and special software to help companies use it as a complete transportation system. They can schedule deliveries for different times and days. They can even have UPS and FedEx integrate shipments. For example, if you buy a computer from Dell, the monitor might have been shipped from Asia, unloaded in a UPS warehouse, and then shipped directly to you—without first having to go to a Dell warehouse. And it would be shipped to arrive at the same time as the rest of the computer, which was shipped from the Dell assembly plant.

In 2006 and 2007, all carriers were hammered by rising fuel prices, both for trucks and airplanes. Faced with increasing costs, IT needs became lower priorities—particularly since no astounding new technology appeared. Rob Carver, CIO, noted that for budget money it is "not a stellar IT year," and that although the FedEx security team likes features on Windows Vista, they see no need to switch desktop operating systems when Windows XP is working fine (Preston 2007).

Competition

The major firms have consolidated to the point where they now offer essentially the same types of services. The declining costs of technology have made it possible for all of the firms to compete with information systems—for example, they all offer package tracking. The rivalry is fierce—particularly between FedEx and UPS. Both compete on the basis of global reach, quality, and price. Currently, DHL/Deutsche Post is not in the same league within the United States, but dominates in Europe and Asia. So, all firms have to focus on efficiency, and efficiency often requires automation—reducing the number of workers where possible, and cutting times as much as possible. All of them have benefited from the increased level of shipping in the past decade. Will that trend continue? Or will it level off, forcing firms to compete harder to steal market share from each other? Information technology has played an enormous role in many aspects of the competition. From providing information for package tracking, to the knowledge bases for international shipping, to route scheduling, automation, and cost cutting.

Teamwork

These companies are huge, and they operate around the world. Moving packages and information quickly and efficiently in this environment requires tremendous teamwork. A large portion of the information technology is devoted to ensuring that everyone down the line knows exactly what is coming. When customers enter package data on the main Web site, the local driver knows what to pick up. Schedulers communicate in real time with drivers to alter routes as needed. The package data is provided to the central hub, which optimizes the plane loadings and flights. Data is sent to customs as well as to the local destination hubs, so drivers know the loads and routes for the next day. All through the process, customers are treated as team members and have access to the information. Customers include the shipper as well as the recipient. Firms that ship products can be notified of any problems before they become a disaster.

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Case: FedEx

The history of FedEx (ticker: FDX) is outlined on its Web site. Federal Express began with a paper that Frederick W. Smith wrote in 1965 while at Yale University. After serving in the military, Smith purchased Arkansas Aviation Sales in Little Rock in 1971. It officially began operations on April 17, 1973, with 14 small aircraft and delivered 186 packages to 25 cities. Deregulation of air cargo in 1977 enabled Federal Express to fly larger jets and the company grew rapidly. In 2004, the company had a daily lift capacity of more than 26.5 million pounds and the fleet traveled 500,000 miles a day. The endpoint delivery vans logged 2.5 million miles a day (company Web site). The company reached $1 billion in sales in 1983—a mere 10 years after start-up.

Mergers

In 1989, Federal Express purchased the Flying Tigers network—largely oriented to flights in the Pacific region, and giving Federal Express expertise in international shipments. In 1995, Federal Express acquired Evergreen International Airlines—largely because the acquisition gave it rights to deliver in China. In 1998, Federal Express expanded into ground deliveries by purchasing RPS (Roadway Package System, renamed Caliber System in 1996). The purchase of Caliber Systems also gave Federal Express Viking Freight. Federal Express expanded its freight system in 2001 by purchasing American Freightways. In 1999, FedEx acquired Caribbean Transportation Services, focusing on shipments to Puerto Rico. FedEx now has a full spectrum delivery system, from air shipping to large freight transfers to package delivery.

In 2000, FedEx acquired TowerGroup and World Tariff. This acquisition provided important knowledge and experience in handling international shipments. It provides customs clearance and electronic filing for all of the other divisions of FedEx, enabling FedEx to provide end-to-end transportation around the world.

The more surprising merger happened in February 2004 when FedEx acquired Kinko's Office stores. For several years, FedEx had a relationship with Kinko's, so that customers could drop off packages at the local stores. All 1,200 stores in 10 countries are digitally connected, making it possible to print documents nationally. The company evolved from neighborhood print shops into local business centers for mobile professionals and small businesses. The company also handles commercial print jobs.

Operations

The essence of package delivery seems easy—when you look at one package: pick up a package, transfer it to a plane, fly it to the nearest airport, put it on a delivery truck, and drop it off at the destination. The problem is that drivers have to pick up many packages, all of them have to be sorted, planes have to be loaded properly and flown to airports where you have landing rights, then packages have to be unloaded, re-sorted into delivery trucks, and the drivers have to get to multiple destinations. Now, you have to do all of that fast and at the lowest possible cost. And the mix of packages and destinations can change every day.

Scheduling and optimizing package handling and deliveries is a key element in the operations. In 1978, FedEx put voice radios in the trucks to assist and direct drivers. Only two years later, in 1980, the company launched a revolutionary proprietary wireless data network called Digitally Assisted Dispatch System (DADS). Dispatchers could send text messages to drivers. By reducing chatter and enabling drivers to check the messages when they needed, the system improved efficiency 30 percent in the first day (Ulfelder 2002). In 1986, the company adopted the wireless handheld SuperTrackers that capture data with bar code readers. The system is the foundation for tracking packages at every step, and uploads data to the Customer Oriented Service and Management Operating System (COSMOS).

Tracking the package at every step in the process is critical to the operations. It provides information for the operations at the next stops, it provides data to the customers, and it makes it almost impossible to lose a package. On average, every FedEx package is scanned 23 times. Once a package is picked up and scanned, the data is transferred to the central computer. At the shipping hub, the computer routes the package to the proper conveyor belt. The package is loaded into an "igloo" container that fits the sloping sides of the plane. The container has a scan that represents all of the items held inside. While being routed to the proper container, each package is weighed and the billing corrected if necessary. The weights are also used to balance the loading of the plane. As the 160 planes land each night at the FedEx hub in Memphis, workers unload them within 20 minutes. Packages in the Memphis hub travel through a giant convey system to be routed to new planes or trucks to the nearest of 22 airports. The system scans 1,000 bar codes per minute. The hub alone generates about 900 MB every two and a half hours (Brewin and Rosencrance 2001). The main FedEx hub in Memphis is a key element in the operations efficiency. FedEx can move 325,000 letters an hour through the hub, along with 125,000 small packages per hour. The average transit time is seven minutes (Brewin April 2004).

In 2003, FedEx rolled out a completely new handheld system. Dropping most of the proprietary technology, the PowerPad was developed by Motorola to run the Microsoft Pocket PC operating system. More important, the system uses the GPRS cellular wireless service from AT&T. It is designed to completely eliminate paperwork, saving couriers 10 seconds at each stop. Which adds up to $20 million in annual savings when you factor in the 3.5 million packages delivered a day (Brewin November 2002). GPRS has data rates between 20 and 40 kbps, which exceed the 19 kbps on the older FedEx network (Brewin March 2002). The PowerPad reduces errors by automatically checking Zip codes. It can print labels through a label printer in the truck that is connected by Bluetooth radio. It even checks the weather at the destination so that the driver can notify the shipper of any potential delays. The PowerPad contains a third radio transmitter so that it can connect via WiFi to the networks at the FedEx hub.

FedEx runs several fully automated sorting hubs. Packages are delivered at one end, then passed on conveyor belts through weighing stations and sorted by ZIP code to be delivered at the other side of the DC onto waiting trucks. Ken Spangler, CIO at FedEx Ground, notes that automation is required to handle the 7,500 packages an hour. He also noted that "Over the last five years, we have been on a mission to get faster and faster. We re-engineer and speed up our lanes an average of twice a year, and sometimes more frequently than that. Over 80,000 ZIP-code-to-ZIP-code lanes are at least a day faster now" (King 2011). An interesting twist to the FedEx DC is that vendors are required to provide a standard interface, instead of proprietary connections. That way FedEx can combine systems from different vendors to achieve the best results at the best prices. FedEx developers create the overall software and can control the performance.

Services

Providing global shipping is considerably more complex than simply transferring a package. Each nation has hundreds or thousands of different rules on tariffs and procedures for importing items. Increasingly, FedEx customers were asking for information on how to ship globally. FedEx began a project in 1997 and launched it in August 2000. Originally, the Web-based system arranged shipments between the United States, Canada, the United Kingdom, Hong Kong, and Puerto Rico. It was then expanded to 20 nations. The system runs on an Oracle database and provides the rules and appropriate import and export forms needed. It also lets shippers know about restrictions, embargoes, and licensing requirements. In February 2001, the Global Trade Manager system began computing government fees, duties, value-added tax (VAT), and other charges so that shippers can quickly estimate the total costs. Robert B. Carter, head of the division, notes that "Global Trade Manager makes it easier to ship internationally, which can be an intimidating experience. It allows customers to do import/export documentation in a straightforward fashion….We are giving them [clients] access to technology they wouldn't otherwise have" (Rosencrance 2002).

In 2003, FedEx partnered with Cap Gemini Ernst & Young to offer detailed logistics services to companies of any size. Many large companies already outsource freight transportation (67 percent), and 42 percent outsource management of their distribution centers. But most firms still maintain control over the rest of the decision aspects of logistics and purchasing (Bacheldor 2003). The new offering from FedEx and Cap Gemini integrates software for transportation-management, fulfillment management, supply chain event management, and business-to-business hub management. With the integrated tools, customers can examine and track shipments and warehouse or distribution center handling at the stockkeeping unit (SKU) or even serial number level. They will be able to see the movement of all products and obtain reports on all aspects of shipping, even though the entire process will actually be handled by FedEx. Douglas Witt, president of FedEx Supply Chain Services, notes that the system is important because "lack of visibility is a major issue for a lot of customers" (Bacheldor 2003).

With the global and domestic presence of FedEx, U.S. government police agencies often turn to the company for information about deliveries and customers. Prior to 2001, FedEx generally declined to cooperate without court orders—fearing retribution against employees and concern about customer privacy. Since the terrorist attacks of 2001, FedEx now encourages its employees to watch for potentially dangerous activity and it works with the FBI and other agencies. FedEx provides access to its international customer databases, including credit-card and payment data. The company also has the legal right to open and inspect any customer package at will—a power not even granted to police. Fred Smith, the founder, ordered the cooperation and sees it as an important service to society. Plus, the cooperation helps prevent delays in package deliveries. FedEx also created a 10-man internal police force that is recognized by the state of Tennessee—giving the company access to police databases and the only private seat on the FBI terrorism task force (Block 2005).

Strategy

Battling head-to-head with UPS and forging entirely new ways of doing business have forced FedEx to focus on strategy. Technology plays a key role in its plans. But Smith is understandably cautious. He shies away from huge projects designed to alter everything. Instead, he says, "We try to do a lot of work on the front end, divide things into bite-size pieces, do things in a more evolutionary way" (Foley February 2, 2004). Exactly how Kinko's fits into that strategy is not completely clear yet, but it will probably take time for the value to be realized. FedEx CFO Alan Graf notes that "it diversifies our business. Kinko's is the back office for hundreds of thousands of businesses" (Foley February 9 2002). Fred Smith notes only that it will enable both companies "to take advantage of growth opportunities in the fast-moving digital economy." Jim McCluskey, a FedEx spokesman, adds that it will enable FedEx to "push information electronically" for its clients (Brewin January 2004). If nothing else, the stores will raise the visibility of FedEx even higher—providing a convenient location for small business services and drop-off points for FedEx shipments. With the stagnant economy, a shift to digital documents, and a tight battle with UPS, the market for overnight delivery has leveled. FedEx is looking to the ground and international shipping to carry its growth forward. Furthermore, the company has to focus on costs to improve profits (Foley January 2004).

In an interesting strategic arrangement, FedEx has two agreements with the USPS that run through August 2008. FedEx uses its planes to help carry Priority, Express, and First-Class Mail as well as the USPS international delivery air service. The second agreement enables FedEx to place 5,000 drop boxes at U.S. Post Offices in 340 metropolitan areas (2006 Annual Report).

Faced with the economic slowdown and rising fuel prices in 2006 and 2007, FedEx made few changes in strategy. However, in 2007 the company announced that it would spend $3.5 billion in fiscal 2008 to build new shipping hubs in China (Machalaba 2007). Most of the expansion in FedEx has been related to services in China and India (2006 Annual Report). On the Kinko's side, FedEx has a deal with Adobe to include a button in Acrobat Reader that sends PDF files to any selected Kinko's store for printing. Users can print documents at an office near a desired U.S. destination and have them delivered for a fee. Initially, 133,000 customers had signed up for the service (Golden 2007).

Teamwork

One of the challenges with growing through mergers is integrating all of the information systems. To maintain the existing efficiencies, FedEx chose to run the new divisions independently. But that means managers do not have a single view of customer data, and customers have to check multiple locations to find their shipping information. In 2004, FedEx began development of its Customer Fusion database. The package will pull data from all of the independent systems and make it available from a single point. The product is a computer messaging system that can talk to all of the individual applications. Larry Tieman, chief architect for the project, notes that "the message bus allows us to loosely couple the business application, apply the proper business rules, and build a unified application layer" (Sullivan 2004).

The company also created an integrated system for international managers in 2001. The international strategic information system (ISIS) uses a Web-based front-end query tool to integrate data from internal legacy systems for marketing, sales, and inventory. It then consolidates information for local agents into an Oracle database. The agents can then query the database and identify patterns such as the amount of shipping by industry. A key aspect of the system is to provide business intelligence data to local agents and FedEx managers. By sharing the same data and analysis, FedEx can better help the agents meet revenue targets (Dash 2001).

Because FedEx develops most of its own applications, it is concerned about software development processes. As it explores options to outsource development and hire teams from off-shore development firms, the company needs a method to test software code. In 2006, FedEx developed a program with the University of Memphis to find new methods of testing software, including multistage system testing, risk-based testing procedures, and an expert system for systems testing (Krill 2006).

FedEx encourages teamwork learning throughout the IT organization. The company has a job swap program, where employees can request to trade jobs for a certain length of time. The swap can include temporary assignments in other countries. The technique provides employees with a broader picture of the business, a chance to see other problems, and to share approaches to solving them (Pratt 2007).

Questions

1. How does FedEx use information technology to improve teamwork and deliver packages more efficiently?
2. How can FedEx integrate data from its diverse companies to improve teamwork, without replacing all of the individual systems?
3. Why is wireless technology so important to FedEx?

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Case: United Parcel Service

The UPS (ticker: UPS) Web site has details on its history and growth. UPS began in Seattle in 1907 as a messenger service, with most deliveries made on foot by teenage boys. In 1913, the fledgling company acquired its first car: a Model T Ford. Merging with a couple of competitors, the company renamed itself Merchants Parcel Delivery and began focusing on delivering merchandise from the retail stores. The company also was the primary carrier of special delivery packages in Seattle for the U.S. Post Office. In 1919, the company expanded to Oakland, California, and adopted its current name: United Parcel Service. After World

War II, retail shopping changed, as customers drove to malls and carried their own packages. UPS fought to provide common-carrier service in new areas, including Chicago. Expanding into competition with the U.S. Post Office raised regulatory issues, and the company fought many legal battles to win the right to deliver packages. In 1953, UPS began shipping cargo on existing airline flights. Yet package delivery had to remain inside a state to avoid regulation by the Interstate Commerce Commission (ICC). Fighting for three decades, the ICC finally granted UPS permission to deliver packages between Montana and Utah—in 1975. By 1985, the company was shipping packages by air to all 48 contiguous states and, in 1988, started its own airline. In 1993, to track the huge number of drivers and deliveries, and to keep up with FedEx, UPS introduced the handheld Delivery Information Acquisition Device (DIAD). In 1999, UPS joined the New York Stock Exchange.

Operations

Fighting competitors from day one, UPS pioneered efficiency in delivery—emphasizing the need to hold down costs and prices. Although UPS headquarters are in Atlanta, it runs its operations through its main Worldport hub in Louisville, Kentucky. The 4 million-square-foot facility handles over 100 planes a night, pushing 600,000 packages a day through the hub. Because of a limited labor pool and the desire to hold wages down, the facility emphasizes automation. It runs on almost 14,000 computer devices, including 30 terabytes of online storage and 5,500 miles of fiber-optic cable. It uses 122 miles of conveyor belts to move packages and sort them by bar code scanners as they fly by (Brewin April 2004). Most of the individual packages (93 percent) are identified by special bar codes. When shippers fill out the shipping labels on the UPS Web site, the system notifies UPS about incoming packages. Twice a day, this incoming information is used to create a sort plan that configures the hub to match the expected packages. The software Flexible Lineup Editor reorganizes the loading and unloading positions to optimize the package transfers. Packages are only touched twice by humans: once to be loaded onto the conveyor belts and once to be taken off and put into shipping containers (Brewin April 2004).

UPS also pays close attention to its drivers and their routes. Drivers are often monitored in terms of performance, and managers share tips on how to improve. In 2003, the company added a new software routing tool to plan the routes. Since most customers provide pickup data early in the day, the computer can plan the optimal route, speeding up the drivers while they make more stops and travel fewer miles. UPS CIO Ken Lacy estimates the system will reduce fleet miles in the United States by more than 100 million miles a year, saving about 14 million gallons of fuel (Brewin September 26, 2003).

UPS had thought about creating a massive routing system since at least the mid-1990s. The catch is that many people thought the problem was too big to solve. In computer science terms, the problem is called NP-complete because there is no perfect solution to analyze the entire delivery problem other than to examine every possible choice. And, with trillions upon trillions of options, no machine could find the perfect solution. Operations research specialists studied the problem and found ways to narrow it down to just examining feasible solutions that are close to optimal. With research and faster machines, they managed to reduce the time to find a solution from 90 days down to three hours. By optimizing its primary routes, UPS was able to cut a day off its guaranteed delivery times for some routes, such as reducing shipping time from Los Angeles to New York from four days to three (Bacheldor 2004).

In 2003, UPS began redesigning its handheld system to the DIAD IV terminal. The terminal contains a color screen and runs on Windows CE. In addition to the bar code scanner, it includes a global positioning system (GPS) receiver. It uses Bluetooth wireless to connect to a label printer in the van. When parked at the hub, the system connects to the local area network via a WiFi wireless connection. On the road, it uses a built-in cellular modem, so that drivers can connect to the network and provide immediate information to customers. Ultimately, the system will be able to use its Bluetooth radio to connect directly to customer computers. The GPS system will be particularly valuable in Europe, where drivers handle less frequent trips. In the United States, many companies require daily deliveries and pickups to fixed locations. But the GPS system will also help route drivers for last-minute pickup requests (Brewin September 26, 2003). In 2005, after two years of development, the DIAD IV was rolled out to all 70,000 UPS drivers. The company spent $22 million to develop the new devices based on Symbol technology and said it would spend $127 million to deploy them globally (Weiss 2005). At the same time, the company reported that it was experiencing problems with its package-flow technology. The analytical system was designed to work with GPS systems to analyze routes and determine the most fuel-efficient directions and loading instructions. Full implementation was projected to be delayed by a couple of years and the system was estimated to save $50 to 100 million in fuel costs each year—down from the $700 million originally projected (Rosencrance 2005).

By 2006, UPS was delivering an average of 15 million packages a day around the world. But UPS still focuses closely on keeping up with FedEx. Using the Internet, UPS is working to collect package data earlier and applying it to loading trucks. When customers fill out the online form to generate a package label, the information is sent to one of the UPS hubs. A computer system sets up a delivery route and identifies where each package should be loaded in the truck, with earlier deliveries stored in the front of the truck. UPS reports that drivers have gained enough time to make an additional seven to nine stops per shift—on top of the 100 pickups and deliveries they handled before the tool. Integrated with the new DIAD IV, the system sounds an alarm if a driver forgets a package or stops at the wrong address (Dade 2006). The technology also enabled UPS to introduce a new service in 2007—delivery intercept. For a $10 fee, senders can use the Web site to stop the delivery of a package or reroute it to a new destination. UPS suggests the service might be useful if a sender realizes at the last minute that the wrong data or package was sent (press release March 26, 2007).

Capital expenditures at UPS were relatively stable over time. In 2006, the company spent $720 million on buildings and facilities, $1.15 billion on aircraft and parts, $831 million on vehicles, and $384 million on information technology. In total, the company spends about $1 billion a year on IT costs, including labor (2006 Annual Report).

In 2010, the UPS Web site was processing more than 26 million package tracking requests a day. But technology is also heavily used in operations to set the most efficient package loading and to define routes for delivery trucks. The handheld technology introduced in 2008 includes telematics, or information about the truck including GPS and automotive sensors that include engine RPM, braking, and speed. The goal is to fine-tune routing as well as track maintenance (2010 Annual Report). The new system took 10 years to design and build and focused on seemingly simple things such as loading trucks more efficiently. The automated system puts tags on boxes so loaders know exactly which order to load them on the truck. Developers also had to find ways to handle poorly-entered data (Mitchell 2008).

Integrated Services

In 2001, UPS purchased the entire chain of 4,000 MailBoxes Etc. stores and renamed them The UPS Store. The chain provides UPS with local contact points for individual and small business pickups. But most of the stores are still run as franchises. The stores are eliminating the need for paper shipping forms. Customers simply enter the data into a kiosk PC (or have the clerk enter it), and it prints out the bar-coded label. In 2003, UPS took the interesting step of testing public-access Wi-Fi in 66 of the retail stores in Chicago. Customers would pay either an hourly or monthly fee to connect their own laptops to the Internet through the WiFi connection. The demand for this service is still uncertain (Brewin September 11, 2003).

In 2002, UPS introduced a Web-based shipping solution to large customers with offices in multiple locations. The system enables employees to ship a package by simply entering the details in a Web site. The system automatically bills the company and provides a comprehensive report to managers. Best Buy is using the system to make it easy for employees in its stores to ship packages to other Best Buy locations or to send them directly to customers. Jim Hay, general transportation manager of small package solutions for Best Buy, observes that because employees do not have to handwrite the labels, "this saves 15 minutes per user per package. The biggest area of savings is in time and (in fewer) lost and misrouted packages due to poor handwriting or a bad address" (Rosencrance March 2002).

UPS began offering a useful service in early 2003 for exporters and importers. The company launched an electronic payment system called UPS Exchange Collect. Basically, UPS collects the money from the recipient/customer. Sellers are free to expand to new markets with unknown customers with minimal risk. UPS drivers will only deliver the product when they receive payment. When the shipper sends an item, the recipient is notified electronically. UPS then collects the money and delivers the package. The money is electronically sent to the seller. The system provides huge gains over the current system. Currently, shippers often wait 90 days for payment—and still run risks that the buyer will not pay. UPS will transfer the funds within 10 days (Rosencrance 2003).

UPS also provides expertise in shipping products internationally—in terms of handling forms and getting packages through customs. By identifying and controlling every package that UPS carries, the company's Worldport hub qualifies as a controlled building for the customs bureau. More important, the product information database is accessible to customs agents, who can scan it for potential problems. Any suspect packages are instantly rerouted within the Worldport hub to the customs office for detailed inspection (Rosencrance March 11, 2003).

In 2004, UPS introduced new tools for customers to use the system as a complete logistics solution. The Quantum View Manage software makes it easy for customers to identify all shipping information. In particular, customers can see all packages as a group, without needing to enter every tracking number. They can see exactly where packages are located, along with any reasons for delays. The system can even trigger alerts if problems arise and notify customer service automatically, or use automated delivery notices to send electronic invoices (Rosencrance 2004).

UPS demonstrated the true power of its integrated logistics system in 2004 by offering a new service to Toshiba. Toshiba outsources all laptop repairs to UPS Supply Chain Solutions. Broken laptops are sent by UPS to its Louisville hub where UPS engineers diagnose the problem, fix the laptop, and return it to its owner. Mark Simons, general manager of Toshiba's digital products division, notes that diagnosing and repairing computers is actually the easy part. Instead, "moving a unit around and getting replacement parts consumes most of the time. The actual service only takes about an hour" (James 2004). UPS has been helping Toshiba with repairs by performing an initial inspection since 1999. UPS has also been servicing Lexmark and Hewlett-Packard printers since 1996.

Questions

1. Does it make sense for UPS to move into the computer repair business?
2. How does the Quantum View system provide new revenue or profits for UPS?
3. How does UPS use the Internet to reduce costs?

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Case: DHL/Deutsche Post

DHL has an interesting history. The company was started and driven by Larry L. Hillblom who loved to fly—particularly among the Pacific islands. Because of this love, DHL focused largely on international shipments and became a leader in Southeast Asia. After Hillblom died in a plane crash in 1995, a huge number of East Asian and Pacific Island women came forward and claimed that they had had children with Hillblom, and that he promised to support them. After hundreds of lawyers and several court battles, four children were shown to be his heirs by DNA testing, but several others received settlement money as well (Metropolitan News-Enterprise 2003). In 2003, DHL was purchased by Deutsche Post. With its strength in Europe, Deutsche Post and DHL provide a strong international solution to shipping (company Web site). In 2004, DHL announced a major commitment to expanding its operations in the United States. In addition to its international ties, the company wants to focus on competing with UPS and FedEx through highly visible trucks and a national marketing campaign (Press Release 2004).

DHL has one of the largest customs-clearance systems of any of the shipping companies. With over 8 million trade rules, the WorldWide Clearance System (WCS) helps millions of packages clear customs throughout Asia and Europe. The process is largely automatic for the shipper. Most items are shipped without intervention. If a problem arises, the system fires a message back to the shipper to handle it. As a result, the customer does not have to constantly monitor the process (Rosencrance 2003).

By the time the recession hit in 2008, DHL had mostly pulled out of local delivery service in the United States. The company is still big in Europe and Asia and it still delivers packages to and from the U.S., but it no longer runs head-to-head against FedEx, UPS, and the USPS in delivering within the United States.

Teamwork

DHL does not have the huge amount of money to spend on IT that UPS and FedEx do. Consequently, it is rarely a leader. But it has made some smart moves in communications networks, and by waiting for prices to drop, it now has the ability to compete with the giants. Alan Boehme, director of business planning in 1998, noted that "the nice thing is Internet technology and the change it enables—inexpensive communication on an open, standards-based network—is like David's rock. I'm not going to say that DHL is going to kill the giant, but Internet technology is the great equalizer for any business" (Sliwa 1998). Actually, even before the Internet took off, DHL made some smart investments. In 1988, the company built a TCP UNIX-based network to connect its offices around the world. Their package tracking data is routed on the internal frame-relay based network. It uses object-oriented technology to integrate data regardless of whether it came from the Web site or the automated phone system. The worldwide network also connects programmers and developers so they can share data electronically and work together even when they are scattered around the globe (Sliwa 1998).

In 2004, DHL expanded its operations to provide radio-frequency identification (RFID) technology and support to its customers. By tagging all packages, the company helps suppliers meet RFID requirements throughout Europe. As worldwide standards are developed, the company wants to expand the program globally. Clems Beckmann, managing director of corporate development at Deutsche Post, notes that "Our goal is to become the core logistics supplier for RFID services worldwide" (Sullivan 2004). In 2007, DHL slowed down the move to RFID in the U.S. noting a lack of demand for the service and the $1 billion cost. The company is a leader in Europe, providing RFID tags and data tracking for Metro AG. The company believes it can add value to shipments of cold perishables such as seafood, and is trying to convince customers to adopt it (Weier 2007).

Information Technology

One problem that DHL experienced in 2001 was that its pricing was too difficult for customers. It could take days for a sales representative to quote a price, and as long as two to three weeks to get final approval from management. Lacking the resources to develop the system themselves, DHL turned to Metreo Inc to automate the process. Going live in 2002, the system provides sales representatives with real-time customer data and pricing information based on the customer's shipment. Tied to the corporate network, the salesperson can suggest an optimal price and receive approval almost immediately, sealing the deal before the customer can be coaxed away by FedEx or UPS (Rosencrance 2002).

In 2002, DHL realized that it needed a new data center to consolidate its operations. Built in Scottsdale, Arizona, the system connects centers in Kuala Lumpur, Malaysia and London. DHL's CIO, Steve J. Bandrowczak, noted that "DHL wanted to create a seamless single offering to our customers, like a single invoice or a single Web interface. In order to enable that global logistics business vision, we had to consolidate our IT infrastructure, which included the data center, our network backbone and our key global applications" (Rosencrance 2004).

Merging Airbone with DHL in 2003 was a challenge for the IT departments. Airborne's system were designed to handle high data volumes rapidly and reliably. DHL, headquartered in Belgium, focused on ground transportation and the complexities of international shipping. DHL also heavily used India's Infosys to integrate IT systems, ultimately resulting in layoffs on the Airborne development team. The Airborne applications, centered in Seattle, were largely based on legacy IBM CICS and DB2 systems. The DHL Americas systems ran in Scottsdale on Hewlett-Packard servers running Unix and Oracle databases. In the first pass, integration required selecting key applications from each platform to keep the systems running, but ultimately, operations were moved to Scottsdale. In 2006, the company began searching for a new integrated system (Whiting 2006).

In terms of development of applications, because of its global nature, DHL turned to offshore development early on. By hiring programmers in the UK, India, and Asia, it is able to develop critical applications throughout a 24-hour day. Colum Joyce, global e-business strategy manager based in Brussels, observed that "for us, large-scale development is not a hothouse environment, it's an everyday reality" (Gilhooly 2001). Using the time differences around the world, development effectively continues around the clock—something you cannot do very well if everyone is located in the same time zone. Plus, the lower turnover rates and low salaries for skilled overseas programmers help hold costs down. Finally, the multilingual and multicultural programmers can tailor the applications to specific nations.

DHL has generally been behind the curve in adopting technology. For example, it lags UPS and FedEx in providing wireless tracking devices to its drivers. Only in late 2006 did the company provide Web-based tools to customers to enable them to track all of their shipments (Rosencrance 2006).

Similar to many companies, DHL faces challenges in hiring and retaining talented IT workers. The company's 1,200 U.S. IT workers had a turnover rate of about 9 percent a year. After surveying workers, CIO Steve Bandrowczak was told that they wanted greater recognition of their work. So he created the "carrot a day" philosophy where workers will be rewarded with items from verbal praise by a manager at a staff meeting, to an e-mail from a senior IT executive, to gift certificates (Hoffman 2005). At the end of 2005, Bandrowczak was named CIO of Lenovo and in early 2006, DHL hired Maryann Goebel, formerly from GM, as the CIO for the Americas and Pacific region.

Deutsche Post faced many challenges as it grew through acquisitions. Each company that it acquired had different forms of accounting and different ways of measuring progress. To standardize the accounting and reporting, the company created the Common Reporting System (CREST). Instead of focusing on cutting costs, the CREST system emphasized sharing data in a standardized format. It is based on the SAP platform and uses an Oracle DBMS to handle the data requirements. The Web-based application is used across 200 countries and provides consistent basic financial data to managers in each area and at corporate headquarters (http://www.cwhonors.org/viewCaseStudy.asp?NominationID=245).

Questions

1. How do RFID tags help Deutsche Post offer new services to customers?
2. What benefits does Deutsche Post gain by using offshore programmers?
3. How does the Deutsche Post information system make it easy for small businesses to ship internationally? Why is this important?
4. How can the Internet enable DHL to compete equally with FedEx and UPS?

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Case: United States Postal Service

The U.S. Postal Service (USPS) has been around for centuries. Sometimes hailed, sometimes maligned, it has struggled to turn a profit. Technically, it is a government agency, but it is not funded by Congress. In fact, the USPS provides free stamps to members of Congress. In exchange, the USPS has a federally mandated monopoly on delivering mail to individual mail boxes. It is also required to deliver first-class mail to any U.S. address for a fixed price. Letters sent to an address down the street cost the same as letters delivered to a rural town in Alaska. Rate changes must be submitted to and approved by a political Postal board of governors. With the advent of low-cost long-distance phone calls and e-mail, the demand for first-class letters has dropped for several years. In 2005 and 2006, the quantity of junk mail carried surpassed the delivery of first-class items (Hall 2007). In response, the Postal Service has continued to increase the price of first-class stamps—driving demand even lower. Most of the mail carried consists of advertising pieces charged at varying rates below first-class postage, but even those rates were increased by as much as 40 percent in 2007. Those rates have increased to the point where some advertisers are testing hand-delivered flyers (Chabrow 2004 and usps.gov).

In 2010 and 2011, the USPS is still struggling to adapt to a digital world. Demand for mail continues to drop, so revenue is declining, and losses are increasing. To compensate, the USPS continues to increase prices and is contemplating reducing services by dropping Saturday mail delivery. In 2011, the agency suspended its employer contribution to the Federal Employee Retirement System because it did not have enough money. The Postal Service was $8 billion in the red for 2010 and risked running out of money before the end of 2011. The agency had already reduced staffing by 110,000 and cut costs by $12 billion, but it was still not enough to keep it alive (Wall Street Journal 2011). From 2001 to 2010, first-class mail volume dropped from 103.7 billion to 78.2 billion pieces (www.usps.com).

Technology

The USPS relies heavily on outside contractors to provide information technology and other infrastructure. For example, for years, the USPS has relied on Lockheed Martin to provide mail handling systems. Several mail-processing centers are run by outside contractors. In October 2004, fearing problems with the bankruptcy filing of MCI, USPS signed a long-term contract with Lockheed Martin to provide telecommunications services as well. At the end of 2006, after some apparently bad experiences, USPS cancelled the contract and returned to MCI as its primary provider (Marsan 2006).

For the most part, the USPS lacks the delivery tools of the giants FedEx and UPS. Workers still sort and deliver individual pieces of mail on fixed delivery routes. But, the task of the workers is quite different because they almost always have to stop at every mailbox every day. Hence, the potential gains from tracking and scheduling are minor. However, in 2003, the organization spent $20 million to develop logistics software to aggregate ZIP code data and map out how to load packages on trucks more efficiently (McDougall 2003).

The mail system was the first to support person-to-person messages across the U.S. and eventually the globe. Consequently, it was also a primary method of propagating scams. The Postal Service's Postal Inspection Service was created in 1909 to investigate various levels of fraud and scams. Various federal laws were enacted over the years to make specific scams a federal crime. You might think the Inspection Service would have no role in today's Web-based e-mail scams. However, any activity, such as mailing a check, that uses the mail system falls under its jurisdiction. If someone orders an item via the Web and it is delivered through the Postal Service, its inspectors can take charge—as happens often in pornography and drug cases. The Service has been involved in tracking several major cyber-scams and attacks (Greenemeier 2007).

With 700,000 employees, the USPS needed a way to train its employees on procedures and rules. For years, it used an internally-developed system. In 2003, USPS purchased a commercial testing learning-management system from Thinq Learning Solutions. Robert Otto, VP of IT, was primarily impressed with the data-capturing capabilities of the tools that validate an employee has completed the course. He said that "we had a hole in the administrative end of managing our training" (George 2003).

Like any other organization, the USPS needs an accounting system to track expenses and receipts. In 2004, the Postal Service began a process to replace its decades-old custom-built applications with off-the-shelf software. In particular, it chose to install Oracle's ERP system beginning with the general ledger. The USPS had already installed Oracle.s Web-based time-and-attendance application in 2001. A Retek Inc. retail accounting software package collects sales data from the 40,000 Postal Service branches and posts them to the Oracle general ledger. Using the Oracle system, the Postal Service was able to reduce its accounting clerical staff by 1,000 positions, reducing expenses between $300 million to $1.5 billion annually in 80 districts. The organization planned to implement an SAP HRM application to handle benefits and promotions data in 2007 (Greenemeier 2005).

In October 2009, the government accounting organization (GAO) evaluated the technology for the Post Office Intelligent Mail Full Service Program. This program was created in 2003 to use barcodes to track mail. The basic conclusion was that the program was only partially finished and that the rest of the project was unlikely to be completed (GAO-10-145).

Some people have tried to search for ways to keep the traditional Post Office alive, but the task seems grim. The Postal Regulatory Commission notes that the Postal Service wants to close thousands of post offices. John Callan, a mailing industry consultant organized conference for June 2011 to help find a future for the Postal Servie. He noted that "I think we need to stage a serious conversation about the future, so that the folks on the Hill can understand what's going on and those of us in the postal industry can learn how we would do something differently" (O'Keefe 2011). Other people and government oversight agencies are even bleaker. The agency relies on first-class mail to fund its operations, but first-class mail volume is plummeting. Two complicating factors are that the union contract forbids layoffs and Congress will not allow closing a Post Office for economic reasons. Through privatization, European postal services have used these tactics to survive, but they are not yet an option in the U.S. (Leonard 2011).

A few people still find the Postal Service valuable—particularly for package shipping. The prices are competitive and often lower than the alternatives (FedEx and UPS). The Postal Service also offers electronic postage. It is now relatively easy to purchase postage online and print an electronic "stamp" on an envelope directly from a PC printer (Khechfe 2010, but note he works for a company that creates electronic postage).

Questions

1. How does the USPS use its Web site to sell services?
2. When was the last time you mailed a letter via first-class mail?
3. What happens if USPS goes under?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Part 3

Decisions and Strategies

How do information systems help managers make better decisions?

How does information technology help teams share information? Can computers make decisions? How can information systems make your company better than the competition?

Business decisions can be complex. Complexity can arise from several areas, including the use of huge amounts of data, difficult mathematical formulations, uncertain relationships, detailed linkages to multiple business units, and physical or procedural constraints. Middle-level managers in all functional areas face complex problems. Various models have been created to help you analyze these problems and evaluate alternative answers. Information technology provides several tools to help managers collect data, evaluate models, evaluate output, and make decisions.

Ongoing research into artificial intelligence has led to additional tools to tackle specific problems. Expert systems, robotics, and neural networks are sophisticated tools to solve complex problems.

Strategic analyses represent some of the most difficult decisions a manager can face. Strategy represents fundamental changes in the operations of the business. Information systems are used to search for useful changes. Information systems have also been useful in creating a competitive advantage.

Chapter 9

Business Decisions

Chapter Outline

What You Will Learn in This Chapter

- How do businesses make decisions?
- How do you make a good decision? Why do people make bad decisions?
- How do you find and retrieve data to analyze it?
- How can you quickly examine data and view subtotals without hundreds of queries?
- How does a decision support system help you analyze data?
- How do you visualize data that depends on location?
- Is it possible to automate the analysis of data?
- Can information technology be more intelligent?
- How do you create an expert system?
- Can machines be made even smarter?
- What would it take to convince you that a machine is intelligent?
- What are the differences between DSS, ES, and AI systems?
- How can more intelligent systems benefit e-business?
- How can cloud computing be used to analyze data?

Citigroup

How do you use information technology to make better decisions? Citigroup is one of the largest banks in the world. And the world part is important: the company operates in 101 countries. Running a global bank requires making thousands of decisions—from basic questions about approving loans to structuring mega-deals with huge corporations. Banks obviously adopted information technology early—to handle basic transactions. After all, money today is really just numbers in a computer. Banks, including Citigroup, have been slower to adopt technology to make decisions; but that reluctance has been changing in the last few years.

Citigroup is faced with competitive pressures as well as disruptions from economic fluctuations. It has attempted to reduce risk by spreading into multiple business areas, including insurance (Travelers), brokerage (Salomon Smith Barney), and investment banking. The company is one of the largest issuers of credit cards in the United States. With stagnant growth of the U.S. credit industry, Citigroup has expanded into South America and even China. Evaluating customers to minimize risk is a key aspect of the credit card industry.

Introduction

How do businesses make decisions? Figure 9.1 shows that as a manager, you will have access to huge amounts of data. How do you analyze it to understand what it means? How can information systems help you make better decisions? These questions are difficult to answer, but there is a much bigger underlying question. Why would companies need to hire you as a manager? Executives already have access to databases containing integrated data for the entire company. ERP systems can provide detailed data on any aspect of the business. EIS systems can show charts, summaries, and detailed data. Now, what if computer systems can be built to analyze the data and make decisions? What job will you have?

Analyzing data and making decisions depends somewhat on the discipline you choose and your background in statistics and operations management. A key aspect in many introductory business courses is to teach you the basic models used within the discipline. It is unlikely that you are an expert in any particular discipline at this point, and you might not be aware of the variety and power of the statistical tools available to analyze data. Nonetheless, you need to learn how information technology can be applied to many business decisions. This chapter focuses on the tools available and illustrates them with relatively simple decisions. Even if you do not fully understand the discipline-specific models, you need to learn what tools are available.

Can computers make decisions? How can information systems help managers make decisions? Some business problems are straightforward. In these cases, developers simply create a set of rules or procedures that the computer can be programmed to follow. As long as the business behaves in a predictable manner, the rules apply and the computer can handle the details. However, many business problems are less structured and cannot be solved so easily. In addition, problems often involve data that is not well defined. For example, it is straightforward to create a computer system to handle inventory because the computer can easily keep track of item numbers and quantity sold. Consider the more difficult prob-

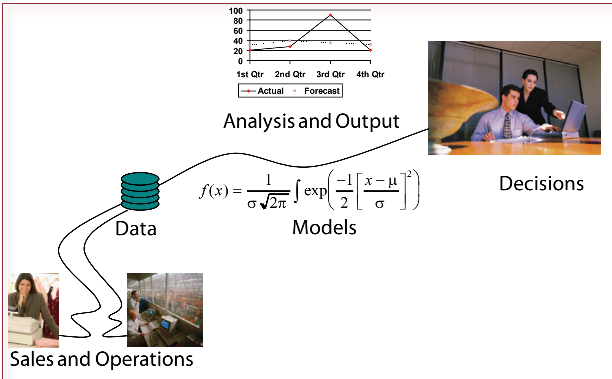


Figure 9.1

Tactical decisions often require complicated analysis. Problems utilize forecasts, optimization, and in-depth analysis. Information systems provide support through data, modeling, and presentation tools. Managers use information system tools to build, evaluate, and maintain various models.

lem faced by a manager who has to decide where to locate a new plant. Some attributes are measurable, such as distance from suppliers, cost of land, and taxes. Other features are difficult to quantify: quality of the labor force, attitudes of government officials, and long-run political stability of the area.

Many problems involve nonnumeric data and complex interrelationships among the various factors. Without computers, businesses often call in experts or hire consultants to help solve these problems. Special software programs called **expert systems (ESs)** provide many of these features. From the beginning, researchers and computer designers have known that humans perform some tasks much better than computers can. These differences led researchers to investigate how people solve problems and investigate how humans think. The research into techniques that might make computers "think" more like humans is known as **artificial intelligence (AI)**. There is some question as to whether it will ever be possible to build machines that can think the same way humans do. Nonetheless, the research has led to some useful tools that perform more complex analysis and can solve difficult problems. These tools attempt to mimic the processes used by humans in a simpler form that can be processed by a computer system.

The answer to the big question is yes, computers can make decisions in some situations. In other cases, the computer is a tool that helps you analyze the data. The level of support provided depends on the type of problem and on your skills as an analyst. As a manager, it is your responsibility to identify decisions that can be handled by machine systems and to recognize when these systems do not work.

It is Hard to Make Good Decisions

How do you make a good decision? Why do people make bad decisions? Most businesses have evolved over time. In many cases, their business processes have been built and patched in response to various changes in the industry. The firms that made better decisions and changes survived, while the others failed. But the existing process might not be the most efficient. Consider the apparently simple process of farming. Farmers feed the animals and then sell

Trends

Through the 1970s, computers were largely used to assist with transaction processing. Support for making decisions was generally limited to the basic reports produced from the data. Computers were too expensive and programming too difficult to be used by every manager. As personal computers became commonplace through the 1980s, managers began transferring data from the corporate central computers to their personal machines. Spreadsheets made it easier to analyze data, evaluate models, and create charts. In the 1990s, networks, improved spreadsheets, and better ties to databases made it possible to build more complex, interactive models and create forecasts.

Along with technology, improvements were made to modeling and analytical tools. Scientific advancements made it possible to add more intelligence to software tools. Data mining systems use statistical tools to semiautomatically evaluate data, searching for important relationships and clustering or classifying groups of data. Expert systems evolved from early work on artificial intelligence. Focusing on narrow domains, these tools encode the rules of an expert to analyze data and suggest solutions. Today, thousands of expert systems are used to improve decisions and provide quick results 24 hours a day.

The study of human brains yielded clues that led to the development of neural networks. Today, neural networks are widely used in pattern matching applications. Humans are good at pattern recognition, and neural networks dramatically improve the ability of machines to perform these tasks.

Writers and researchers have long wondered whether machines can become intelligent. No one is close to an answer yet, but the new technologies mean that today's systems are more intelligent and can handle more complex problems than machines a few years ago. As the range of solvable problems increases, managers need to understand the capabilities and limitations of each method.

them. The hard part is that the animals can be fed and housed many different ways—each with different costs. Should the animals be fed high-protein food that costs more and grows bigger animals faster, or should they be fed simple diets and take more time to mature? In the 1970s and 1980s, experts created software that analyzed these questions from the standpoint of minimizing the cost of feeding the animals. Using optimization methods, they were able to substantially reduce the production costs. But some experts have found it is possible to do even better by focusing on profits across the entire industry chain. The same types of problems apply to any business process, because most companies solve individual problems first because they are easier. As tools become better, it is important to expand the perspective and look at broader decision problems.

Even if you do have a system for making a better decision, you need to convince managers to use it. Many managers distrust new technologies and different answers, because they see an element of risk. A few companies have established a culture that focuses on continual improvement and growth. In these companies, managers are encouraged to explore new ideas and replace the existing processes.

Reality Bytes: Google's Self-Driving Cars

Following the successes of the DARPA Grand Challenges of the late 2000s, some companies have expanded research and development of self-driving cars. Interestingly, Google has been one of the leaders. Perhaps driven by ties to Stanford (which one the second Grand Challenge), and by the importance of mapping in Google. In 2010, Google told the world that it had been using off-the-shelf components to test run self-driving cars a total of 150,000 miles—with almost no human intervention. However, a little know aspect of Google's methodology is that humans first drive the cars around the test area—largely to provide a more specific map of the route, stoplights, school zones, and so on. Chris Urmson, technical lead for the Google project, and a leader from the Carnegie Mellon team that won the 2007 DARPA Urban Challenge, notes that "There are things that right now are a challenge for us. For instance, if most of the world stayed the same but the lanes are shifted—so the physical road didn't move, but for whatever reason, the department of transportation decided we should drive a half lane to the left—that would probably confuse the car today." The challenge lies in unexpected events—getting the software to recognize and react to them using some level of common sense. Ultimately, the tradeoff is an interesting question in ethics: Does a machine have to be perfect? The National Highway Traffic Safety Administration (NHTSA) noted that in 2008 the U.S. experienced 5.8 million car accidents, with 1.6 million of those resulting in personal injuries and 34,000 in deaths. If machine-drivers can cut that rate in half, would we still blame the developers for the remaining accidents?

Adapted from Nick Chambers, "Hands-Off Training: Google's Self-Driving Car Holds Tantalizing Promise, but Major Roadblocks Remain," *Scientific American*, May 23, 2011.

Figure 9.2

Sample decision. Do you invest your money in Company A or Company B? Be careful, it is a trick question.

Figure 9.3

GM 1984 models. Note the body similarities. Even the base color offerings were the same. How could GM throw away its division strategy and offer virtually identical models? Source: Wikipedia.

Human Biases

Assume you have money to invest in the stock market. Someone shows you two companies. As shown in Figure 9.2, Company A's share prices have risen by 2 percent per month for the last year. The other's share price was flat for five months but has increased by 3 percent per month since then. Which stock do you buy? But wait a minute. How can you possibly decide based on the little information you have? It sounds silly, but people make these decisions with minimal data and no logical analysis every single day. When people make decisions this way, the results are going to be inconsistent and dangerous. But it is so much easier to make a snap decision, and so much harder to do the research and complex analyses to make the right decision.

Consider a true example: designing a new automobile. The automobile industry, epitomized by GM in the early 1980s, presents an interesting example of making decisions. GM demonstrated from the 1940s forward that people buy cars based on design and appeal—not simply a collection of features. In particular, GM demonstrated that customers can be heavily persuaded by style and advertising. Assuming you have money, what kind of car would you buy? Sporty, luxurious, flashy, utilitarian, big, small? What color? How many doors? Now ask a few friends or relatives what they would buy. Will all of the answers be the same? Not likely. Now think about the problem from the perspective of an automobile manufacturer such as General Motors. What features are car buyers going to demand in two or three years? This classic marketing problem is difficult to solve. For years, GM used its multiple divisions to create separate identities that appealed to different segments of the population. Designers within each division focused on the preferences and lifestyles of their specific target. Most of that structure fell apart in the early-1980s with the introduction of a completely new line of cars based on the A-body. At that time, the GM divisions introduced a new car model from four main divisions. As shown in Figure 9.3, all four cars (Oldsmobile Cutlass Ciera, Pontiac 6000, Chevrolet Celebrity, and Buick Century) were virtually identical.

Acquisition/Input		
Bias	**Description**	**Example**
Data availability	Ease with which specific instances can be recalled affects judgments of frequency.	People overestimate the risk of dying due to homicides compared to heart disease.
Illusory correlation	Belief that two variables are related when they are not.	Ask any conspiracy buff about the death of JFK.
Data presentation	Order effects.	First (or last) items in a list are given more importance.
Processing		
Inconsistency	Difficulty in being consistent for similar decisions.	Judgments involving selection, such as personnel.
Conservatism	Failure to completely use new information.	Resistance to change.
Stress	Stress causes people to make hasty decisions.	Panic judgments and quick fixes.
Social pressure	Social pressures cause people to alter their decisions and decision-making processes.	Majority opinion can unduly influence everyone else: mob rule.
Output		
Scale effects	The scale on which responses are recorded can affect responses.	Ask a group of people to rate how they feel on a scale from 1 to 10. Ask a similar group to use a scale from 1 to 1,000.
Wishful thinking	Preference for an outcome affects the assessment.	People sometimes place a higher probability on events that they want to happen.
Feedback		
Learning from irrelevant outcomes	People gain unrealistic expectations when they see incomplete or inaccurate data.	In personnel selection you see how good your selection is for candidates you accepted. You do not receive data on candidates you rejected.
Success/failure attributions	Tendency to attribute success to one's skill and failure to chance.	Only taking credit for the successes in your job.

Figure 9.4

Biases in decision making. Without models, people tend to rely on simplistic "rules of thumb" and fall prey to a variety of common mistakes. These errors can be minimized with training and experience in a discipline. They can also be minimized by having computer systems perform much of the initial analysis.

Model Building

Understand the Process

Models force us to define objects and specify relationships. Modeling is a first step in improving the business processes.

Optimization

Models are used to search for the best solutions: Minimizing costs, improving efficiency, increasing profits, and so on.

Prediction

Model parameters can be estimated from prior data. Sample data is used to forecast future changes based on the model.

Simulation

Models are used to examine what might happen if we make changes to the process or to examine relationships in more detail.

Figure 9.5

The four primary reasons for building and using models. Descriptive, graphical, and mathematical models can be used for each of these purposes. However, mathematical models tend to be emphasized for optimization and simulation.

The available colors were even the same—particularly maroon. In effect, GM was assuming that millions of customers all wanted the same car.

Designing cars, or any product, is a difficult decision problem. In good situations, like GM, you have tons of data available. You have sales data, data on competitors, surveys, and focus groups. But, the results are meaningless if you cherry-pick data to match your preconceived ideas. "*Oh look, here are 5,000 people who want larger engines.*" If you search hard enough, you can find data to match any opinion you want; but it will not accurately represent the opinions of the population.

In response to these problems, Barabba and Zaltman, two marketing researchers working with GM, analyzed decision making at General Motors and noticed that several common problems arose. In summary, they found that people are weak at making decisions. For example, people place too much emphasis on recent events, they tend to discard data that does not fit their prior beliefs, they follow rules of thumb instead of statistical analysis, and they choose outcomes based on wishful thinking. As shown in Figure 9.4, all of these problems and more influenced the decisions of designers at GM. In particular, they found that the designers tended to discuss ideas with their bosses in an attempt to identify management preferences that would help get a particular design approved. So cars were designed to the preferences of a few managers, instead of to the needs of customers. Despite attempts to improve, the fiasco eventually forced GM to eliminate the Oldsmobile division. The books written by Barabba and Zaltman discuss even more examples and human biases in decision making.

Before you think that businesses (and GM) have solved the design problem, go look at current designs. In 2008, the *Wall Street Journal* examined cars produced by GM and Ford and found similar overlap in styles within each company. And GM's overall market share continued to decline at least through 2009, when the company was forced to file for bankruptcy protection—when the company sold off or eliminated several other divisions. The main point to remember is that making decisions without a good model and process leads to poor decisions. Sure, you might get lucky for a while (like investors in the 1990s), but ultimately you need a solid decision-making process.

Models

Models are key aspects to any decision; they are simplifications designed to help you understand and analyze a problem. Many of the models you will use in business decisions were created by academics. You will be introduced to many of these models in other business courses. As a manager, you are responsible for knowing that hundreds of models are available to help you make decisions, and for knowing which model best applies to the problem you are facing. Understanding and evaluating models is an important aspect of a business education.

Models often use drawings and pictures to represent the various objects. However, at heart they typically use mathematical equations to represent the process and the various relationships. For example, an operations engineer would model a machine as a mathematical formula that converts raw materials and labor into products. Using equations for each step of the production process, the engineer could search for ways to reorganize production to make it more efficient or to improve quality.

Models are used to help managers make decisions. Most businesses are far too complex for any single person to understand all of the details. Consequently, a variety of models may be created to present a simplified view of the business. In particular, one of the original purposes of accounting was to create a standardized model of the financial aspects of business. Another common model of business is the practice of dividing the company into functional areas. For example, a manager with experience in the finance department of one company can usually apply knowledge and problem-solving skills to finance departments in other companies and even other industries. The basic goals are summarized in Figure 9.5. Models help you simplify the world. They help you search for similarities in different situations. Models also enable managers to predict how changes might affect the business. As the decision maker, it is up to you to determine which models to use and to make sure they actually apply to the situation. Once you have selected the appropriate model, you apply whatever data you have, evaluate the results, and make the decision.

Prediction and Optimization

An important use of models is for **prediction**. If a model is reasonably accurate, it can be used to predict future outcomes. For instance, when you buy a car, you might want to know how much it will be worth in three years when you want to sell it. It is possible to estimate how the price of used cars changes over time.

Prediction first requires that you have a model that describes the situation. Then data is collected and statistical techniques are used to estimate the **parameters** of the model for the specific problem. Next you fill in values for any parameters that you already know, and the model provides a prediction. Prediction techniques such as regression and time series forecasting are used to examine the data, identify trends, and predict possible future changes. To use statistics effectively requires a model of the underlying system. For instance, to use regression methods you

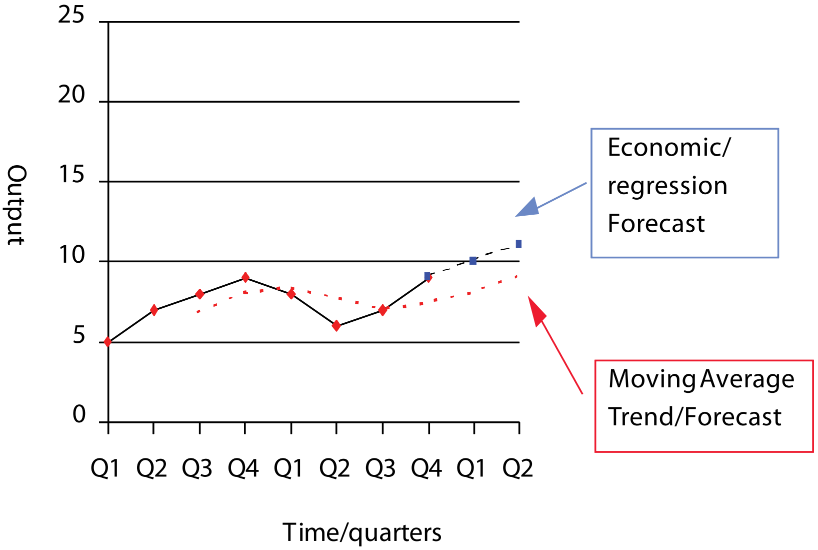


Figure 9.6

Prediction model. Several statistical techniques exist for analyzing data and making forecasts. Two common methods are regression and moving averages. Both methods require substantial amounts of data. Choosing between the two requires some expertise in statistical analysis, but many times we display both methods to show a range of possible outcomes.

first identify the dependent variable and a set of possible independent variables. These choices come from the underlying model.

Figure 9.6 illustrates how a spreadsheet can be used to display the results of a forecast. Although dedicated statistical packages contain more options, spreadsheets contain several tools to help with basic statistical regression and forecasting. Once you load the Data Analysis toolpak in Excel, you can run basic regressions, T-Tests, or ANOVA to identify how a set of independent X variable affect the dependent Y variable. You can use the trend line function to highlight averages on charts. If you are familiar with statistical functions, you can use the built-in functions to make comparisons and evaluate data. You can also purchase add-ins to perform more-sophisticated analysis of your data. When you need even more power, you can use the import and export tools in the high-end statistical software packages to extract and analyze your data. You might have to hire a statistician to help determine which tools you need and to create the initial models. But once the model and system are configured, you can run the system to analyze your results on a regular basis.

Optimization

Optimization evaluates a model in terms of the inputs or control parameters and searches for the best solution. Optimization requires a detailed mathematical model. Several tools such as linear programming are used to find optimal values. Some optimization models have resulted in substantial savings in cost or increases in profit. Tasks that are repeated hundreds or thousands of times can often benefit through optimization modeling.

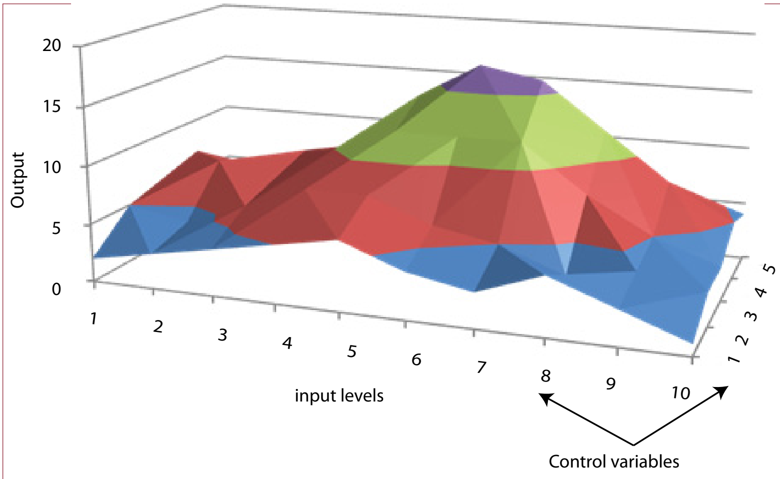


Figure 9.7

Optimization model. Optimization requires a mathematical model. Output is defined in terms of various input variables. The maximum point can be found by altering the values of the input variables. Special software, such as linear programming tools, can help evaluate complex models.

Figure 9.7 shows a simple optimization model with two input variables and a single output. Optimization typically requires a mathematical model that describes the complex relationships between the variables. You will often use statistical techniques to estimate the underlying model parameters, and then turn to optimization tools to find the best operating point. Linear programming is an optimization tool that has demonstrated considerable success in solving some relatively complex problems. As the name implies, basic tools assume that all of the relationships are linear, but modern tools can support a limited amount of nonlinearity, including quadratic terms.

The Solver tool that is sold with Excel is a limited version of a commercial optimization product, but even the basic version is capable of solving moderately-large problems. If your model grows too large, you can upgrade to the full version or purchase software from other companies. One of the strengths of the linear programming (and Solver) approach is that it is designed for constrained optimization problems—which are common in business. Operations research and management classes explain these problems in more detail. The problems are a little tricky to set up, so you should consult an expert if you lack experience with these problems. The key is to identify the output goal (perhaps profit maximization or cost minimization), and then list all of the input variables that affect that result. Once you have defined the optimization equation, you need to specify all of the constraints that affect the problem. For example, a production plant has a maximum amount that can be produced; and people work a limited number of hours a week producing a defined amount of output per person and machine. Once you understand optimization, you will recognize that it can be used to solve a variety of problems, including complex pricing decisions, worker scheduling, product mix, and input selection.

Reality Bytes: Make Decisions by Putting Down the Cell Phone and Going for a Walk

If you think choosing what to eat for dinner is tough, stay away from combinatorial auctions. Consider an airline that wants to bid on landing slots at an airport. The slots can be bid on individually or in bundle of combinations. Data includes the passenger loads, weather, and connecting flights. Angelika Dimoka, director of the Center for Neural Decision Making at Temple University, uses these types of complex puzzles to study the ability of humans to make decisions. She used functional MRI (fMRI) to examine brain patterns while volunteers worked on these puzzles. At the start, increasing the amount of data caused activity in the dorsolateral prefrontal cortex region of the brain to increase. This region is responsible for decision making and control of emotions. However, as the amount of data increased, activity suddenly dropped as the humans reached overload. At that point, frustration and anxiety soar as the emotions take over. Other research into human aspects of decision making show that unconscious systems guide human decisions and that decisions that require creativity benefit from patience—allowing the brain to think about the problem passively. But interrupting the brain with increasing amounts trivia makes it more difficult for the brain to operate. It is one of the reasons pilots and first responders train for emergencies and maintain checklists of critical tasks. Studies, such as those by Shenna Iyengar of Columbia University, show that providing more choices and more data can cause people to give up and simply opt out. For instance, employees who faced retirement plans with more options tended to opt out more often than those with fewer choices. The brain needs time to evaluate data, integrate the elements, and determine which items to ignore. So, collect the data, use analytical tools and models that were developed for the problems, try to identify the most important factors, then take a break and let the brain evaluate the choices for a while.

Adapted from Sharon Begley, "I Can't Think!" *Newsweek*, March 7, 2011.

Simulation or "What-If" Scenarios

Simulation is a modeling technique with many uses. Once a model is created, managers use simulation to examine how the item being studied will respond to changes. With simulation, various options can be tested on the model to examine what might happen. For example, engineers always build models of airplanes and engines before they try to build the real thing. The models are much cheaper. In fact, most engineers today start with mathematical computer models because they are cheaper to create than physical models and can contain more detail. Moreover, they can perform experiments on models that would not be safe to perform in real life. For example, an engineer could stress a model of an airplane until it broke up. It would be dangerous and expensive to try such an experiment on a real plane. Similarly, a business model could examine what would happen if prices were increased by 20 percent, without worrying about losing real money. Of course, the model is only useful and valuable if it accurately reflects real conditions.

Most simulation models are mathematical instead of descriptive models, because they are easy to evaluate. Mathematical models contain parameters, or variables that can be controlled by the managers. For instance, you might use a spreadsheet to create an accounting model of an income statement and balance

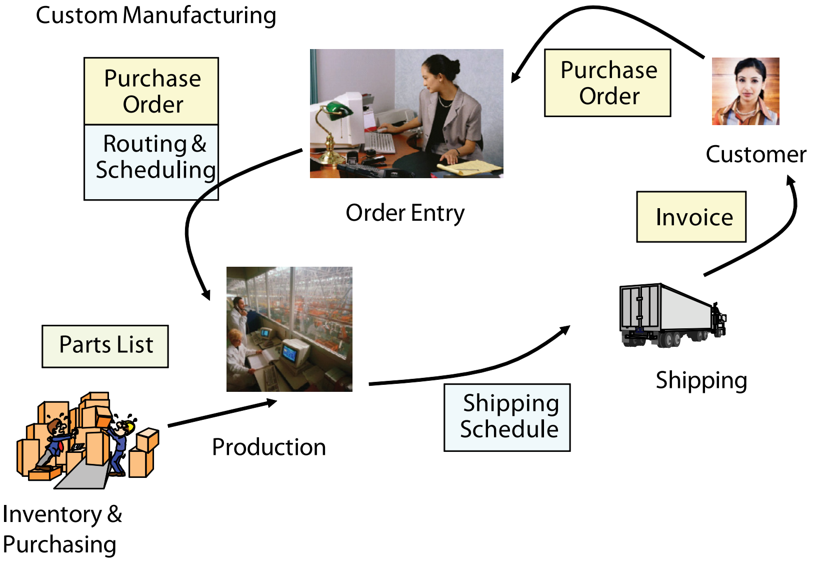


Figure 9.8

Object-oriented simulation. A simple example of custom manufacturing. Each object (parts list, purchase order, etc.) and each process are defined in detail by the modeler. The simulation system generates orders, makes shipments, and orders inventory according to programmed rules. The simulator collects a variety of statistics that can be displayed graphically or in summary reports.

sheet. When you create the spreadsheet, production quantity and price of your products are controllable parameters that affect the income and profits of the firm. You could use the model to investigate decisions, like the effect on profits if you increase production. Costs will increase, but so will revenue from sales. The net result depends on the specific details of the firm and the model. Spreadsheets are often used to analyze small models and graph the results. More sophisticated simulation packages can support more complex analysis and will automatically create graphs and pictures to show interrelationships.

More complex models provide more opportunities for simulation. In part because they are difficult to solve and understand. In a production system, a more detailed model might enable you to investigate alternatives such as increased overtime, hiring another shift, building additional plants, or subcontracting the work to another firm.

Object-oriented simulation tools developed in the last few years make it easy to create many simulations. As shown in Figure 9.8, you can place icons on the screen to represent various business objects. Behind each of these objects, you specify their behavior. For example, you would need to estimate the average number of customers that arrive in an hour and how long they are willing to wait for service. For physical processes like order entry, inventory, and shipping, you specify the number of transactions that can be handled in a given time. When all of the details have been entered, the system runs simulations and tracks statistics. You can change the parameters such as adding clerks to see what happens if you change the operations.

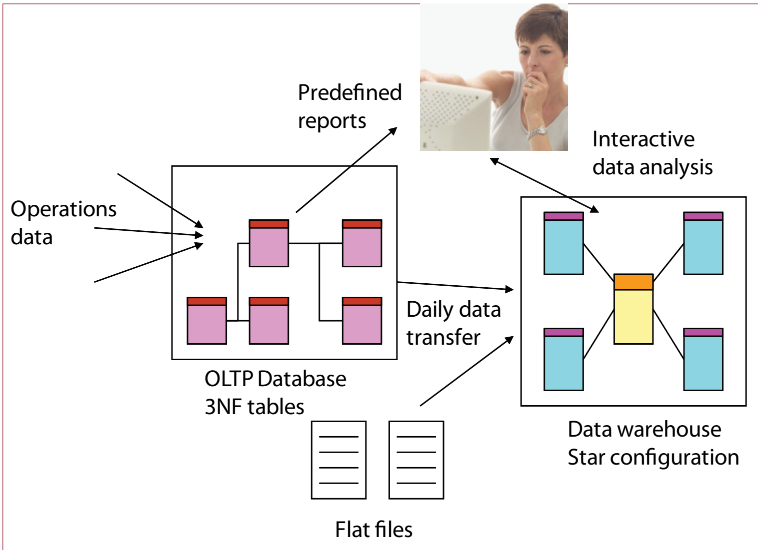


Figure 9.9

Data warehouse. A data warehouse is commonly used as a method to provide data to decision makers without interfering with the transaction-processing operations. Selected data items are regularly pulled from the transaction data files and stored in a central location. DSS tools query the data warehouse for analysis and reporting.

Data Warehouse

How do you find and retrieve data to analyze it? ERP and other transaction systems can provide enough data to bury you. But the transaction systems are designed to store data, not to search and analyze it. Relational databases turn out to be relatively slow when you need to analyze several gigabytes or even terabytes of data. If you do not have an ERP system, you have even greater problems trying to integrate and clean data from all of your systems. As shown in Figure 9.9, the answer is to create a separate **data warehouse** that extracts and stores the data in a clean, easy-to-analyze format. The process shown in Figure 9.9 is known as **extraction, transformation, and loading (ETL)**. Larger database management systems have specific tools and data storage methods to create data warehouses. Some companies also create specific **data marts** that are basically copies of a small portion of the data warehouse designed to feed a specific application. For instance, a financial data mart might be used by the accounting and finance department just to monitor investments and bank accounts.

Finding and cleaning the data is the most time-consuming step in most data analysis projects. Data is often stored in multiple systems and proprietary formats. Even if the data is stored in a DBMS, someone has to verify the data content and format to ensure it matches exactly with the other data. Even a number as simple as sales could be defined differently by various departments. Some departments might count sales when a customer signs a contract, but others might wait until the contract has been approved by top management. Sometimes organizations are not even aware that these differences exist—until they decide to start integrating the data.

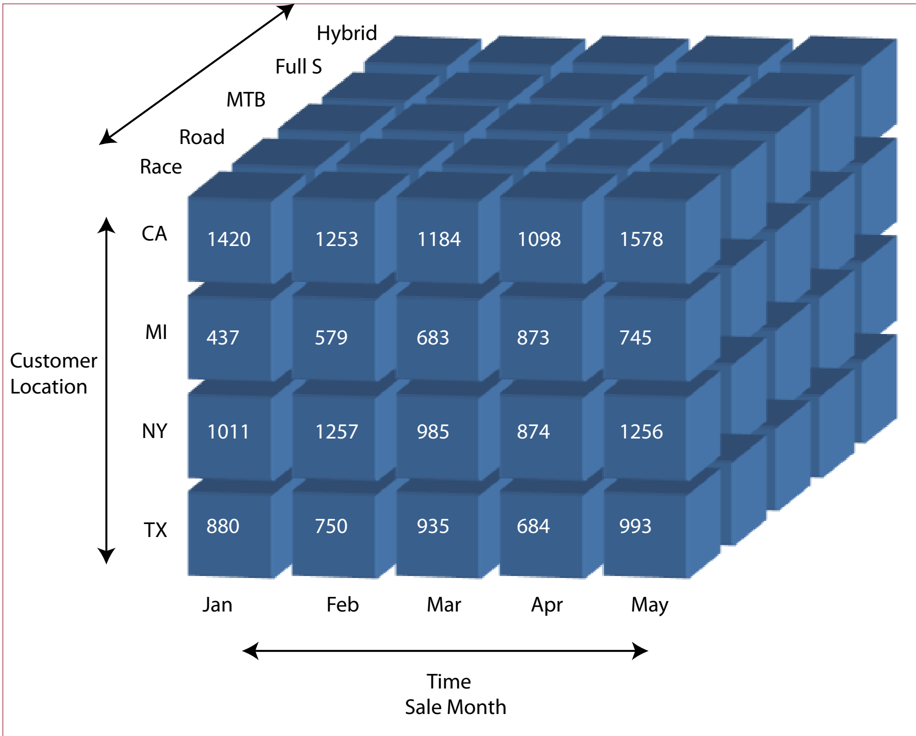


Figure 9.10

Multidimensional cube for item sales. Managers are interested in various combinations of the dimensions. For example, total item sales of dog items in the last quarter. OLAP tools rapidly provide answers to questions involving any perspective of this cube.

Documenting the data is critical because managers have to understand what each item represents and they need to be able to find specific items. **Metadata** is used to describe the source data, identify the transformation and integration steps, and define the way the data warehouse is organized. A data warehouse represents a subset of the total data in the company. In most cases, it is a static copy that is refreshed on a daily or hourly basis. This type of system is relatively easy to use; managers do not have to learn data access commands (SQL or QBE). However, it is less flexible than using a database management system. Decision makers will be unable to get additional data or to compare the data in some previously unexpected way. The success of a data warehouse depends on how well the manager's needs have been anticipated.

Online Analytical Processing (OLAP)

How can you quickly examine data and view subtotals without writing hundreds of queries? Retrieving data and examining totals from different perspectives is an important part of making decisions. When the problem is unstructured and there is no existing mathematical model, it often helps to look at subtotals of data. Sometimes it is useful to browse through the data and examine various subtotals. Which customers bought the most? Click: there are the totals. Which employees sold the most? In December? Click: see the totals

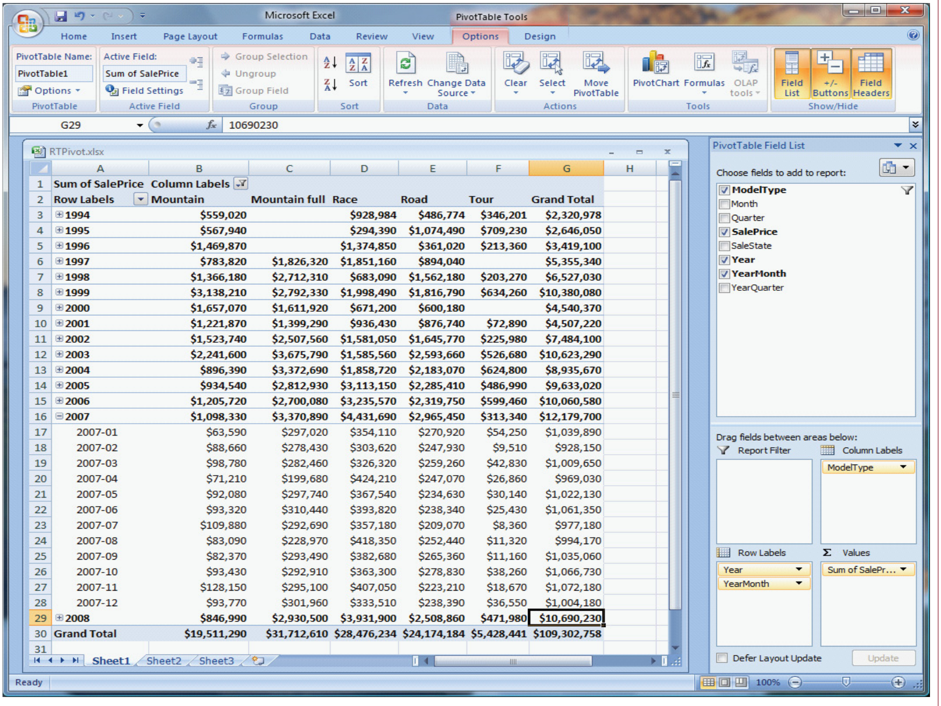
Reality Bytes: Face Recognition

The general public is easily misled by science fiction and Hollywood. It is easy to think that computers can do anything, or that breakthroughs are only a few months away. But, computers still struggle at some tasks that humans perform easily. Most of these tasks fall into the category of pattern recognition, and face recognition is just the latest example. Many photo sites use facial recognition technology to help users identify new photos. For example, Google's Picasa automatically tries to tag new photos by matching faces to existing photos, which simplifies organization and makes it easier to share them. But the system often fails. One user, Stacey Schlittenhard, noted that "All babies kind of look alike—they all have little round faces. If I label one baby as my son, it will label almost every baby as my son." She also noted that Picasa once labeled a lollipop as her friend. Yi Ma, an associate professor of electrical and computer engineering at the University of Illinois, and a researcher at Microsoft Research in China, notes that "I don't think, currently, any facial recognition system is good enough for security purposes—not even close, actually. He also believes a reliable system is at least a decade away. On the other hand, in June 2011, when Vancouver fans rioted after losing the last round of the NHL championship, several photos of people were published on the Internet. Within days, people on the Web had identified most of the rioters and two people who were caught passionately kissing in the middle of the street. Similarly, someone posted a video of a woman arguing with a subway conductor in New York and she was quickly identified by people who watched the video. In that sense, computerized facial recognition is not the threat to privacy—the prevalence of cameras and the ability to share them on the Web is removing anonymity in everyday life.

Adapted from John D. Sutter, "Why Face Recognition Isn't Scary – Yet," *CNN Online*, July 9, 2010; and Brian Stelter, "Upending Anonymity, These Days the Web Unmasks Everyone," *The New York Times*, June 20, 2011.

or view a chart. This process is a major function of **online analytical processing (OLAP)**. Most OLAP tools rely on a data warehouse to provide consistent data and fast access.

The ability to browse through the data is a useful feature of OLAP. Most decision makers want to see subtotals of data. A key method of organizing OLAP data is to identify a key fact (often sales) and then collect attributes that presumably affect the fact. As shown in Figure 9.10, OLAP tools depict this data as a multidimensional cube. Managers use specific tools to examine various sections of the data. To illustrate the process, consider a simple example from the Rolling Thunder Bicycle company database. Managers are interested in sales of bikes. In particular, they want to look at sales by date, by the model type (race, road, mountain, full suspension, and hybrid), and by the location of the customer. The fact they want to measure is the value or amount of the items sold, which is the price times the quantity. The OLAP tools enable managers to examine any question that involves the dimensions of the cube. For instance, they can quickly examine totals by state, city, month, or category. They can look at subtotals for the different categories of products or details within individual states. The tools can provide detail items that can be pictured as a slice of the cube, or they can provide subtotals of any section. Each attribute represents a potential subtotal. In terms



Sum of SalePrice	Column Labels					
Row Labels	Mountain	Mountain full	Race	Road	Tour	Grand Total
1994	$559,020		$928,984	$486,774	$346,201	$2,320,978
1995	$567,940		$294,390	$1,074,490	$709,230	$2,646,050
1996	$1,469,870		$1,374,850	$361,020	$213,360	$3,419,100
1997	$783,820	$1,826,320	$1,851,160	$894,040		$5,355,340
1998	$1,366,180	$2,712,310	$683,090	$1,562,180	$203,270	$6,527,030
1999	$3,138,210	$2,792,330	$1,998,490	$1,816,790	$634,260	$10,380,080
2000	$1,657,070	$1,611,920	$671,200	$600,180		$4,540,370
2001	$1,221,870	$1,399,290	$936,430	$876,740	$72,890	$4,507,220
2002	$1,523,740	$2,507,560	$1,581,050	$1,645,770	$225,980	$7,484,100
2003	$2,241,600	$3,675,790	$1,585,560	$2,593,660	$526,680	$10,623,290
2004	$896,390	$3,372,690	$1,858,720	$2,183,070	$624,800	$8,935,670
2005	$934,540	$2,812,930	$3,113,150	$2,285,410	$486,990	$9,633,020
2006	$1,205,720	$2,700,080	$3,235,570	$2,319,750	$599,460	$10,060,580
2007	$1,098,330	$3,370,890	$4,431,690	$2,965,450	$313,340	$12,179,700
2007-01	$63,590	$297,020	$354,110	$270,920	$54,250	$1,039,890
2007-02	$88,660	$278,430	$303,620	$247,930	$9,510	$928,150
2007-03	$98,780	$282,460	$326,320	$259,260	$42,830	$1,009,650
2007-04	$71,210	$199,680	$424,210	$247,070	$26,860	$969,030
2007-05	$92,080	$297,740	$367,540	$234,630	$30,140	$1,022,130
2007-06	$93,320	$310,440	$393,820	$238,340	$25,430	$1,061,350
2007-07	$109,880	$292,690	$357,180	$209,070	$8,360	$977,180
2007-08	$83,090	$228,970	$418,350	$252,440	$11,320	$994,170
2007-09	$82,370	$293,490	$382,680	$265,360	$11,160	$1,035,060
2007-10	$93,430	$292,910	$363,300	$278,830	$38,260	$1,066,730
2007-11	$128,150	$295,100	$407,050	$223,210	$18,670	$1,072,180
2007-12	$93,770	$301,960	$333,510	$238,390	$36,550	$1,004,180
2008	$846,990	$2,930,500	$3,931,900	$2,508,860	$471,980	$10,690,230
Grand Total	$19,511,290	$31,712,610	$28,476,234	$24,174,184	$5,428,441	$109,302,758

Figure 9.11

Microsoft PivotTable report. Pivot tools make it easy for managers to examine cube data from any perspective, to select subsets of the data, to perform calculations, and to create charts.

of database queries, think of an OLAP cube as a collection of GROUP BY statements. However, the browsing tools are interactive and show managers the results instantly. For example, you can use checkboxes to select specific states. You can begin looking at total sales of all bikes, and then look at the detail by model type. With a few clicks, you can choose a specific slice of the cube, such as one state, and then look at data for a single month or model type, or rotate the cube and look at totals by month.

Although most DBMS vendors (including Microsoft, Oracle, and IBM) provide OLAP cube browsers, Microsoft provides the PivotTable interface that works with almost any DBMS or spreadsheet. A PivotTable is an interactive interface to a multidimensional cube. A PivotTable is created on the user's machine—most users will build pivot tables inside of Microsoft Excel. This tool has several options and provides a great deal of flexibility for the user.

A PivotTable report for Rolling Thunder Bicycles is shown in Figure 9.11. By clicking on a row or column dimension, managers can see detail or subtotals. They can also select specific items to include in the subtotals. Managers even have the flexibility to drag the dimensions around—to move them from columns to rows, or to change the order of the summations. The four windows in the lower-right-hand corner specify where each item will be displayed, and you can drag-and-drop the columns across those windows. Additional options provide other statistics, such as averages.

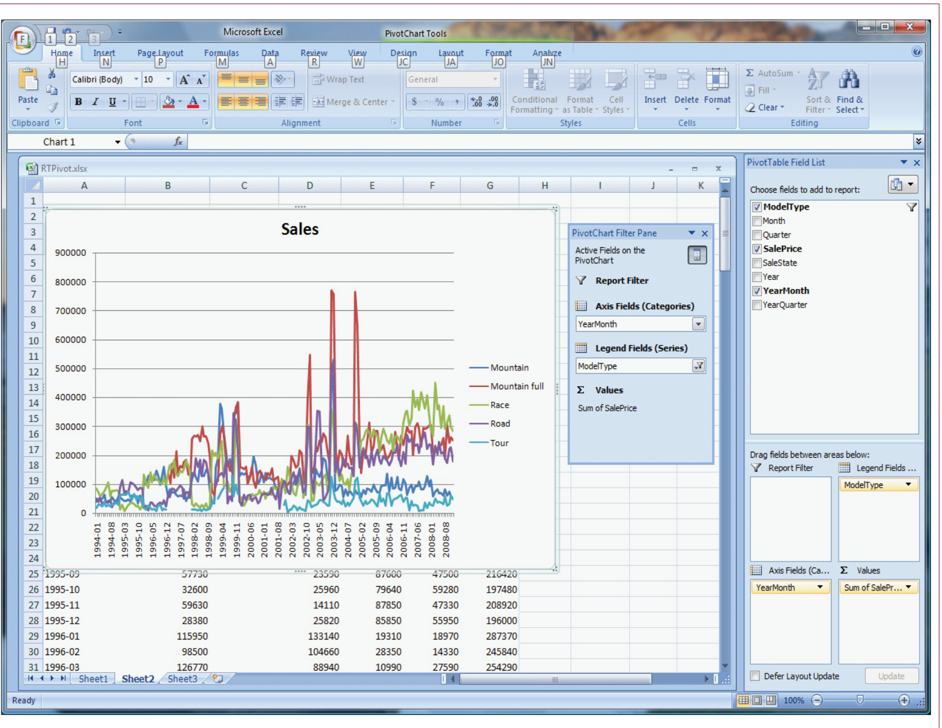


Figure 9.12

Microsoft Pivot Chart. A Pivot Chart uses the same type of data as a PivotTable, but displays the data graphically. It is easy to change the type of chart or to change the data displayed by clicking options or dragging attributes to different sections.

The Pivot Chart graphics option makes it easy to create charts—using the Excel interface that is familiar to most business managers. As shown in Figure 9.12, the system uses the same data as the PivotTable, but creates interactive charts to display the data visually. Once the connection to the data is made, you select the basic chart type and pick the attributes to be displayed. You, or your manager, can change the chart type easily, and even drag data columns to look at new relationships. The options are similar to those in the standard Excel charting package. But remember that the system is interactive, and you can quickly look at any relationship of interest. The data connection is also dynamic, so that as the data changes in the underlying database, you can refresh the chart or PivotTable to get up-to-date values without altering the spreadsheet or chart design.

Several vendors provide interactive cube browsers. Microsoft and Oracle have versions built into their DBMS reporting systems so that you can embed them on a Web report—giving managers Web access to these tools. The PivotTables and Charts built into Excel are convenient and accessible to most organizations without spending additional money. Even if your data is stored in other Excel spreadsheets, you can build PivotTables and Charts that extract the data from other spreadsheets and provide the same interactive data browsing. Additionally, you can use the statistics, functions, and programming capabilities of Excel to analyze the extracted data.

Internal	Purchase	Government
• Sales • Warranty cards • Customer service lines • Coupons • Surveys • Focus groups	• Scanner data • Competitive market analysis • Mailing and phone lists • Subscriber lists • Rating services (e.g., Arbitron) • Shipping, especially foreign	• Census Income Demographics Regional data • Legal registration Drivers license Marriage Housing/construction

Figure 9.13

Common marketing data sources. There are three primary sources of marketing data: internal collections, specialty research companies, and government agencies. Detailed data is available on the industry, customers, regions, and competitors.

Decision Support System

How does a decision support system help you analyze data? Once you have the data, you often need to analyze it statistically, or by applying discipline-specific models. A **decision support system (DSS)** consists of three basic components to help you analyze data: (1) data retrieval, (2) model evaluation, and (3) visualization of the results. Today, a data warehouse or OLAP cube is often used as the data source. The model is often developed by experts (usually consultants) and evaluated in a spreadsheet. The visualization component generally consists of charts, but more sophisticated time lines and schedules are used for complex problems.

To understand the value of a DSS, it is easiest to work with a couple of examples. Thousands of examples exist, but they often require detailed knowledge from a specialized discipline. On the other hand, most managers will need some familiarity with marketing and with human resources management. The examples are relatively small and you will cover more complex models in other business classes. The principles are the same, and you can often use the same tools. Along the same lines, if you want to apply these models to real business problems, you will have to collect more data and add more features to the models.

Marketing Forecasts

Marketing departments are responsible for market research, sales forecasting, management of the sales staff, advertising, and promotion. In some firms they also process orders and manage the design of new products and features. Processing orders is essentially a transaction-processing task. The others involve tactical or strategic questions that are more complex, so we will focus on those tasks.

An enormous amount of data is available for market research. Figure 9.13 presents some of the common data available for marketing purposes. Internally, the marketing department maintains records of sales and basic customer attributes. With some firms, there can be a longer distance between the firm and the final customer. For instance, manufacturers typically sell products to wholesalers, who place the products in individual stores, where they reach the final customer. In these cases it is more difficult to identify customer needs and forecast sales. There

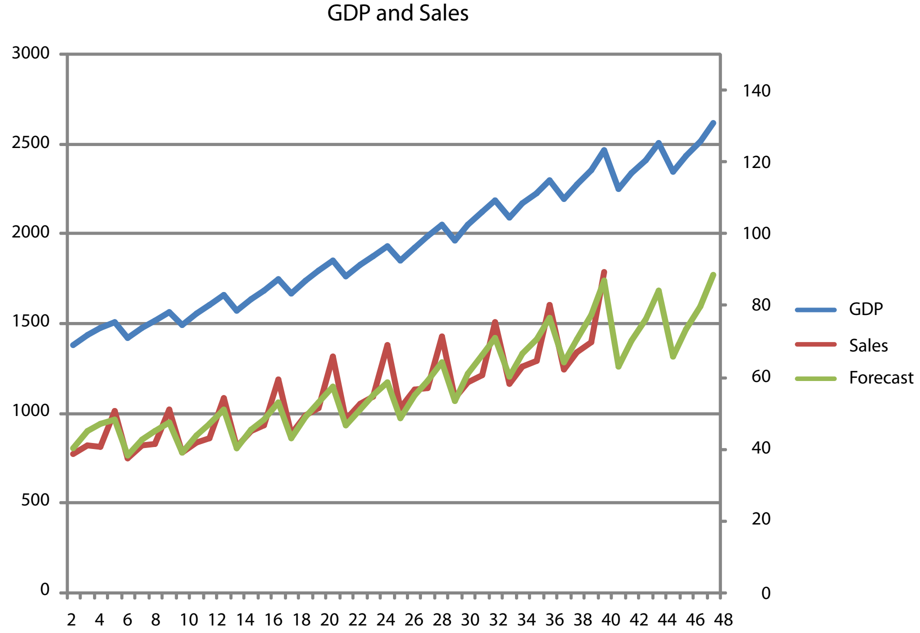


Figure 9.14

Sales forecast. Note the seasonal peaks in the fourth quarter. The points beyond quarter 40 are forecasts based on time and the relationship to income (GDP). This forecast requires that GDP predictions be made for each future quarter, but these values can often be obtained from government forecasts.

will be delays in receiving sales data because the retailers and wholesalers typically place bulk orders. Furthermore, it is more difficult to identify customer preferences because their purchases are filtered through other companies. Marketing departments also have access to data that is collected by other firms. In a manufacturing environment, marketers might get raw sales data from the wholesalers and retailers. On the retail side, with the pervasiveness of checkout scanners, it is now possible to buy daily and hourly sales records from thousands of stores in various cities. This data contains sales of your products as well as rivals' products.

Marketing is often asked to forecast sales. Several different methods can be used, but a straightforward approach is to begin with statistical forecasts. Consider a simple example shown in Figure 9.14 for a fictional store that sells consumer products nationwide. The sales estimate is based on economics where sales are dependent on time and on consumers' income. As consumer income increases, they will be more likely to purchase the company's merchandise. Gross domestic product (GDP) is often used as a proxy for consumer income.

Notice the seasonal peaks in sales for each fourth quarter. It is important to capture this holiday sales effect. Since national GDP and household income have this same effect, you can build a model based on the relationship of your sales to GDP and time. The process is described in Figure 9.15, and all of the steps can be performed in a spreadsheet. Regression provides the estimate of the coefficients that describe the relationship between sales and GDP and time. The R-squared value is over 90 percent and all of the coefficients have high t-values, so it is a strong relationship. If you look closely at the forecast values for the fourth quarters, you will notice some errors that indicate the model is missing some elements.

Data:Quarterly Sales and GDP for 16 years.

Model: Sales = b0 + b1 Time + b2 GDP

Analysis: Estimate model coefficients with regression

	Coefficients	Std. Error	T-Stat
Intercept	-48.887	13.631	-3.586
Time	-0.941	0.294	-3.197
GDP	0.067	0.011	6.326

Output: Compute Sales prediction. Graph forecast.

Figure 9.15

Forecasting process. All of these steps can be performed by a spreadsheet. To forecast the quarterly GDP values, simply split them into four columns, one for each quarter. Then use the spreadsheet's linear forecast tool to extend the columns.

Forecasting the GDP is a little tricky, so most people just use government forecasts. But be careful to get nonseasonally adjusted values (which are difficult to find), so they show the quarterly cycle. Unfortunately, the U.S. Bureau of Economic Analysis has been reporting only seasonally adjusted data since 2004. You can also forecast the quarterly values yourself. The easy way to preserve the cycle is to forecast the quarters independently (all first quarters, all second quarters, and so on). Then plug these values in for the forecast, multiply by the estimated coefficients, and graph the result. It might not be quite as accurate as a full time-series estimation technique, but any business student can make it work, and it is better than guessing or wishful thinking.

Human Resources Management

An important HRM task in any organization is the need to allocate raises. Using a merit pay system, each employee is evaluated on the basis of factors related to his or her job. Typically, each manager is given a fixed amount of money to allocate among the employees. The goal is to distribute the money relative to the performance appraisals, provide sufficient incentives to retain employees, and meet equal employment opportunity guidelines. Many of these goals are conflicting, especially with a finite amount of money available. To set the actual raises, managers need to examine the raw data. On the other hand, a graph makes it easier to compare the various goals.

A few specialized software packages can help you determine merit raises. However, as shown in Figure 9.16, it is possible to create a small system using a spreadsheet. A spreadsheet that can display a graph alongside the data tables is particularly useful. Assume that the company wishes to give a certain portion of the raise based on the average performance ratings. The amount of money per point (currently $100) can be changed. Each person can be given an additional market adjustment raise. The total departmental raises cannot exceed the allocated total ($10,000).

				Merit Pay				raise pool		10000				
	perf.			pct	salary range (000)			current	merit	market	total		New	
Name	R1	R2	R3	perf	low	high	avg	salary	100	adjust.	raise	raise pct	salary	Pct Range
Caulkins	9	7	6	73%	28.4	37.5	36.4	35.8	733	800	1533	4.3%	37.3	0.98
Jihong	3	6	7	53%	15.4	18.9	16.3	17.9	533	100	633	3.5%	18.5	0.90
Louganis	8	7	7	73%	26.7	30.2	28.9	29.5	733	850	1583	5.4%	31.1	1.25
Naber	9	8	8	83%	19.5	23.2	21.4	19.8	833	1030	1863	9.4%	21.7	0.58
Spitz	3	4	3	33%	17.3	22.4	18.4	17.5	333	600	933	5.3%	18.4	0.22
Weissmuller	5	4	6	50%	32.5	60.4	45.2	53.2	500	2955	3455	6.5%	56.7	0.87
Department	6.2	6.0	6.2		23.3	32.1	23.8	21.7	3665	6335	10000	5.7%	30.6	0.83
Corporate	5.0	6.0	5.0		124.3	124.3	18.9	18.9		Remain	0			

Figure 9.16

Merit pay analysis. With a merit system, salary increases should be related to performance evaluations (denoted r1, r2, r3). Managers are typically given a fixed pool of money to distribute among the employees. Employee raises should be based on merit evaluations, current salary, the salary range for the job. Market adjustments are often paid to attract workers in high-demand fields. A spreadsheet can be used to model the effects of various policies. In this example, the manager has allocated $100 for each merit percentage point. The rest of the money will be given as market adjustments. The effects of the adjustments can be seen in the graph displayed in the next figure.

The goal is to fill in the market adjustment column so that the raises match the performance appraisals. As illustrated by the graph in Figure 9.17, the manager can evaluate both absolute dollar raise or the percentage increase. The total departmental raises should be equal to $10,000. By displaying the graph next to the last columns in the spreadsheet, it is possible to watch the changes as you enter the data. This immediate feedback makes it easier to set the raises you prefer. Use of some type of DSS analytical system is helpful for identifying and minimizing illegal discrimination in salaries.

As shown in Figure 9.16, you can use the Office 2010 conditional formatting feature to create a simple chart to show where each person's salary falls within the defined range for the job category. The additional chart is somewhat difficult to read, but it does provide useful information. Also, if the system has access to data across the organization, it is possible to statistically analyze the raises assigned by each manager to ensure raises are given in a non-discriminatory fashion. Such a system will probably be unlikely to catch small deviations, but if systematic differences across managers or individuals appear, HR managers can investigate further. The main point of this example is that managers can visually see the effects of their decisions.

Many, many other problems can be analyzed with decision support systems. The key to a DSS is that you need a model to analyze. Typically, an expert will create the model and build a DSS that loads current data. Managers still need to understand the model and the results, because they are the ones who ultimately analyze the data and make the decisions.

Geographical Information Systems

How do you visualize data that depends on location? Many aspects of business can benefit by modeling problems as geographical relationships.

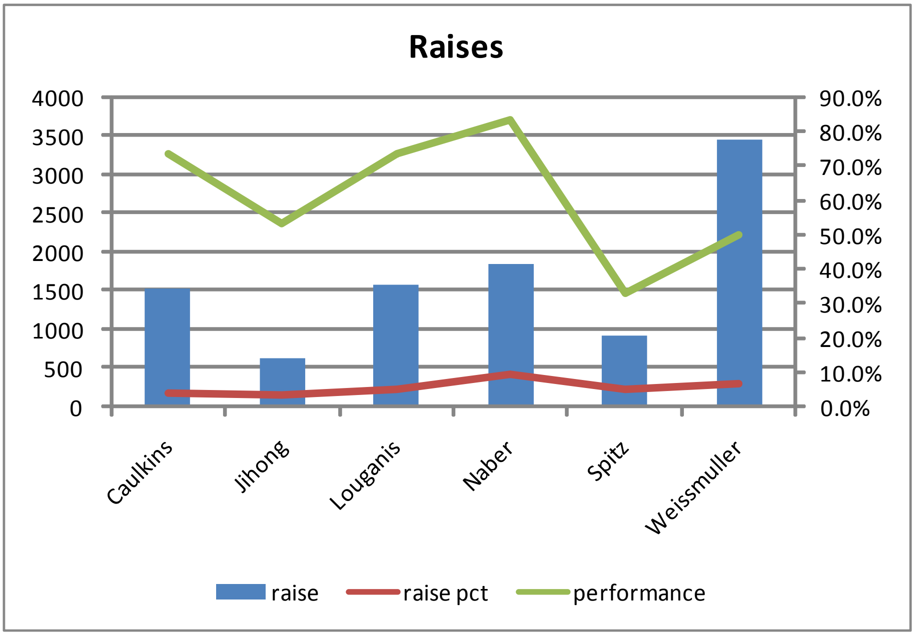


Figure 9.17

Performance evaluation. Using a separate y-axis for the two types of data and overlaying line plots on the bar chart makes this graph easier to read. If this graph is dynamically linked to the salary table, the manager can make salary changes and instantly compare the raises to the performance ratings.

For instance, to choose the site of retail outlets, you need to know the location and travel patterns of your potential customers as well as the locations of your competitors. Manufacturing can be made more efficient if you know the locations of raw materials, suppliers, and workers. Similarly, locations of distribution warehouses need to be chosen based on retail outlets, manufacturing facilities, and transportation routes. Thousands of other geographical considerations exist in business, such as monitoring pollution discharges, routing and tracking delivery vehicles, classifying areas for risk of crimes and fire, following weather patterns, or tracing migration paths of fish for commercial fishing. **Geographic information systems (GISs)** have been designed to identify and display relationships between business data and locations. Arc Info and Microsoft's MapPoint are two of many commercial GIS packages available.

A GIS begins with the capability of drawing a map of the area in which you are interested. It might be a world or national map that displays political boundaries. It might be a regional map that emphasizes the various transportation routes or utility lines. It might be a local map that displays roads or even buildings. An oil exploration company might use a map that displays three-dimensional features of a small area. A shipping company could use ocean maps that display three-dimensional images of the ocean passageways. The level of detail depends on the problem you wish to solve.

Maps and Location Data

Most maps today are built from digitized map data. Each item is stored as a geographic point or line segment; defined by latitude, longitude, and altitude. The maps are drawn mathematically from a collection of these points. Consequently, the maps can be drawn to any scale and the tools make it easy to zoom in or out at will. Most U.S. digital maps are based on data that the Bureau of the Census created for the 1990 national census, known as TIGER. The Bureau of the Census has every road and house number entered into a giant database. Because of privacy reasons, they will not sell house locations, but you can get the range of street numbers for each city block. The U.S. Department of Defense has digital data available for many areas, including international locations, and often includes elevation data. The U.S. Geological Survey topographical maps are also being converted to digital systems. However, keep in mind that the systems being mapped are constantly changing, so even digital maps often contain missing, incomplete, or inaccurate data—as the United States learned when it accidentally blew up the Chinese embassy in Belgrade because the CIA maps were out of date. Due to the popularity of online mapping systems, several private companies work to add new data and fix errors.

Several companies have integrated satellite photos into their mapping systems. Through a variety of programs, the U.S. government has accumulated and released low-resolution photos of most areas of the planet. A couple of private companies supplement those photos with images captured from vans driving through major cities. Computers can match the digital map data with the satellite photos and the drive-by photos to provide realistic views of many cities.

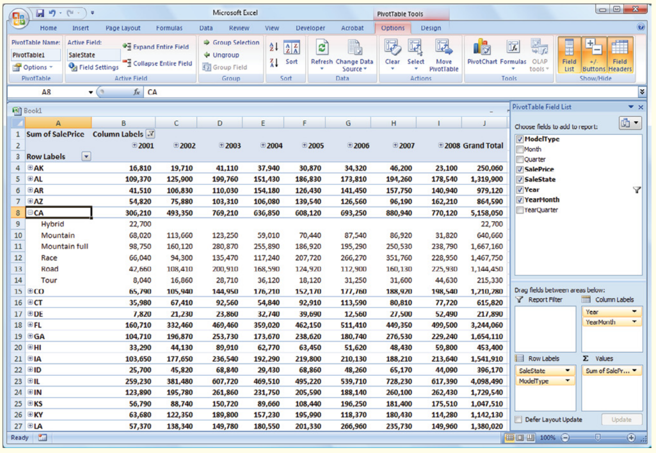
Once you have the base maps, the objective is to overlay additional data on the maps. For example, you can obtain census data that displays average consumer characteristics such as income, house price, and number of autos within each geographic area. The GIS could be used to plot different colors for each income level. Next you can overlay the locations of your retail stores. If you are selling a high-price item such as a Cadillac, you want to locate the stores in areas of higher income.

Although you can buy base geographical data, how do you know the location of your retail stores? Or how do you plot the locations of delivery vehicles, or police cars, or trains? The easiest answer today is to use the **global positioning system (GPS)**, which is a set of satellites maintained by the U.S. government. A portable receiver tuned to the satellites will identify your location in latitude, longitude, and elevation (if it can reach four satellites) within 20 feet. Several handheld units are available for a few hundred dollars. If you work for the Department of Defense, you can get receivers that will identify your location within a few millimeters, but you need appropriate security clearances to obtain these receivers. Currently, the government is broadcasting the higher-resolution signal to civilian receivers, but sometimes blocks it during emergencies. Civilian models that combine signals from U.S. and Russian satellites provide even better resolution, but cost about $8,000. Europe has been trying to raise the funds to build its own GPS system (Galileo) and China has announced that it intends to create its own system as well. There is probably not enough money, or orbital space, for that many satellites; but competition is good and should encourage the U.S. to keep the system open.

As a model, the GIS makes it easier to spot relationships among items. Visual presentations are generally easy to understand and are persuasive. A GIS can be an

Technology Toolbox: Browsing Data with a PivotTable

Problem: You and your manager need to analyze sales based on several attributes.
Tools: OLAP cube browsers are designed to make it easy for you to examine slices of the cube and examine a fact (sales) based on several dimensions. The big DBMS vendors sell cube browsers with their packages. However, you can also use the Microsoft PivotTable that is built into Excel.



The Rolling Thunder Bicycle data provides a good example for a cube. The fact to be evaluated is the SalePrice. The more interesting dimensions are OrderDate, ModelType, and SaleState. The date presents a common problem: dates are hierarchies. You might want to examine sales by year, or you might want to drill down and see sales by quarter or month. Some cube browsers make it easy to create this hierarchy. Excel does not create it automatically, but you can use a query to convert the date into the different dimensions. The qryPivotAll query shows you how to compute the various year, month, and quarter fields.

In an Excel worksheet, use the Data/PivotTable option to begin. Select the External Data Source option because the data comes from a DBMS. Follow the basic steps to get data from a Microsoft Access Database and select your copy of the Rolling Thunder database. In the Query Wizard, find the qryPivotAll query, and select all of its columns by moving them to the right side box. Follow the Next and Finish prompts to return the data to the spreadsheet.

The structure of the PivotTable contains a space for row variables, column variables, page variables, and the main fact. Drag Year and YearMonth from the field list onto the table column location. Drag the ModelType and SaleState fields onto the row location. Finally, drag the SalePrice onto the main body of the table. You can place the remaining fields in the page location if you want to make them easy to find later.

The fun part is playing with the cube. Select a Year heading and click the minus button to collapse the detail. Do the same with the ModelType or SaleState column. Watch as the totals are automatically updated. Drag the ModelType or SaleState field heading to swap the order. Collapse or expand the field to summarize or drill down into the data. You can just as easily expand only one year or one state.

Quick Quiz:

1. How is the cube browser better than writing queries?
2. How would you display quarterly instead of monthly data?
3. How many dimensions can you reasonably include in the cube? How would you handle additional dimensions?

City	2000 pop	2009 pop	2000 per-capita income	2009 per-capita income	2000 hard good sales (000)	2000 soft good sales (000)	2009 hard good sales (000)	2009 soft good sales (000)
Clewiston	8,549	7,107	15,466	15,487	452.0	562.5	367.6	525.4
Fort Myers	59,491	64,674	20,256	30,077	535.2	652.9	928.2	1010.3
Gainesville	101,724	116,616	19,428	24,270	365.2	281.7	550.5	459.4
Jacksonville	734,961	813,518	19,275	24,828	990.2	849.1	1321.7	1109.3
Miami	300,691	433,136	18,812	23,169	721.7	833.4	967.1	1280.6
Ocala	55,878	55,568	15,130	20,748	359.0	321.7	486.2	407.3
Orlando	217,889	235,860	20,729	23,936	425.7	509.2	691.5	803.5
Perry	8,045	6,669	14,144	19,295	300.1	267.2	452.9	291.0
Tallahassee	155,218	172,574	20,185	27,845	595.4	489.7	843.8	611.7
Tampa	335,458	343,890	19,062	25,851	767.4	851.0	953.4	1009.1

Figure 9.18

Geographic sales data. We suspect that sales of hard and soft goods are related to population and income. We also want to know whether there are regional patterns to the sales.

effective means to convince management that neighborhoods have changed and that you need to move your retail outlets. A GIS can also be used for simulations to examine alternatives. For example, a GIS oriented to roadmaps can compute the time it would take to travel by different routes, helping you establish a distribution pattern for delivery trucks.

Example

Consider the problem faced by a manager in a small retail chain that has stores located in 10 Florida cities. It sells a combination of hard goods (such as cleaning supplies, snack items, and drapery rods) and soft goods (mostly clothing). For the most part, profit margins for soft goods are higher than for hard goods. However, total sales of hard goods seem to be better than those of soft goods—except in certain stores. The manager has been unable to find a reason for the difference, but a friend who has lived in Florida longer suggested that there might be some geographical relationship. The basic numbers are presented in Figure 9.18.

Because there are only 10 cities, it might be possible to identify patterns in the data without using a GIS. However, an actual firm might have several hundred or a few thousand stores to evaluate. In this case, it is much more difficult to identify relationships by examining the raw data. It is better to use a GIS to plot the data. Different colors can be used to highlight large increases in sales. By overlaying this data with the population and income data, it is easier to spot patterns. Notice in Figure 9.19 that there is a correlation between population and total sales. Also, notice that sales in the northern cities are concentrated more in hard goods than in the southern cities. Each of the radar charts in the north points to the northwest (left), while those in the south point to the northeast (right). Once you see this pattern, it becomes clear; yet it is difficult to see the pattern within the raw data, or through any other chart.

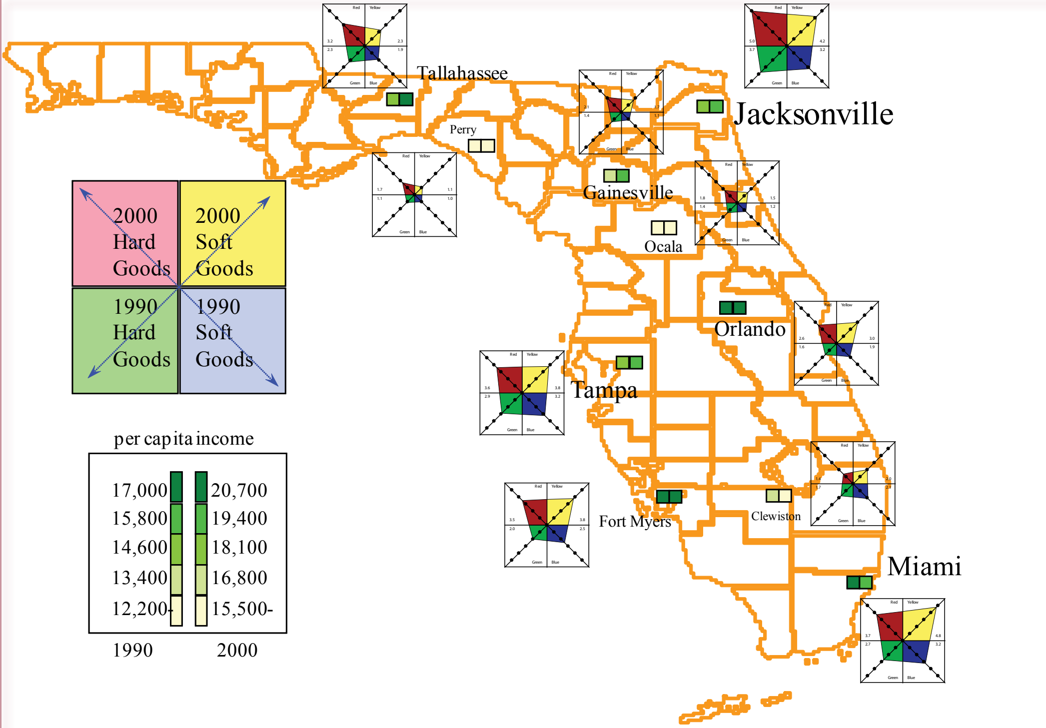


Figure 9.19

Geographic-based data. It is difficult to display this much data without overwhelming managers. Notice that the sales (radar) graphs use size and shape to highlight total sales, and the changing sales mix. Income is color-coded in a smaller graph. Notice in the sales graphs that the northern counties experienced a greater increase in sales in hard goods compared to the southern counties.

Most GIS tools use simpler methods of displaying data. Figure 9.20 shows a common approach where geographic regions (states) are shown in darker colors for higher values. The chart was created by creating a query in Access to compute sales by state for the year 2008. Microsoft Map Point was then used to draw the map and shade the values by state. Map Point also includes demographic data from the U.S. Census Bureau at relatively detailed levels that can be added to the chart. More sophisticated, and more expensive, tools such as ESRI's ArcInfo can display multiple layers of data using overlays. Google maps (and Microsoft's Bing) provide some simple GIS tools using their online systems. The benefit is that the tools are free, but the options available are limited. Typically, you can display only push-pins to highlight specific locations. However, they do support some programmatic tools so you can automatically create charts from your Web server.

Data Mining

Is it possible to automate the analysis of data? Many decision makers, particularly researchers, are buried in data. Transaction-processing systems, process control, automated research tools, even Web sites all generate thousands,

Figure 9.20

Geographic-based data. Tools such as Microsoft Map Point often display location-based data by shading geographic regions based on the relative levels of the data. This map shows sales by state for Rolling Thunder Bicycles in 2008.

millions, or even billions of pieces of data a day. Sure, you can retrieve the data into a data warehouse, run queries, or put it into a spreadsheet, but it is still difficult for humans to comprehend raw data.

Data mining consists of a variety of tools and techniques to automatically retrieve and search data for information. Originally, the term was derogatory because it represents an undirected search for relationships. Statistically, results obtained from nonscientific searches can be spurious and not repeatable. On the other hand, the tools can find minute comparisons that are not ordinarily found through traditional statistical methods. As the flood of data increases, more companies are turning to automated and semiautomated tools to help search databases and make it easier to visualize patterns. Additional models and research can then be used to investigate and validate the relationships.

Data mining tools exist for numerical and other types of data. The numerical tools tend to be based on statistical theory. The others sometimes use statistical theory but are often highly specialized. For example, event analyses look for patterns in data based on timing or sequence—such as the path viewers take through a Web site. This chapter focuses on the more generic statistical tools because they are used in many different companies and tasks. The specialty tools typically require a detailed background in a specialty discipline, so you can learn more about them when you study specific topics.

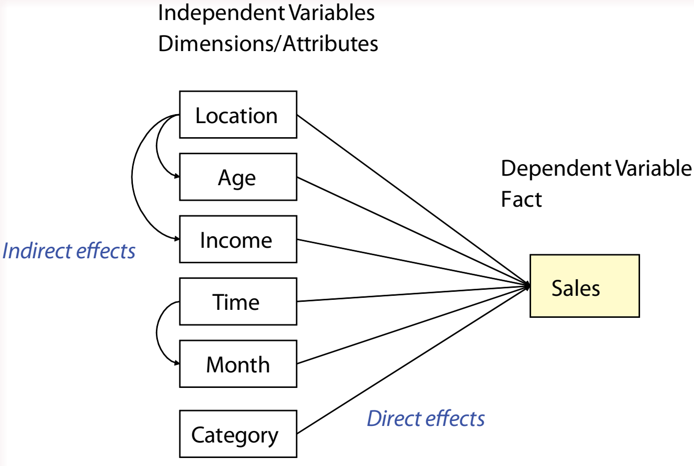


Figure 9.21

Common data mining task. Determine how independent variables affect the dependent fact variable. Models can have direct or indirect effects. Basic linear models are easy to estimate, non-linear ones are harder to estimate and more difficult to understand.

As shown in Figure 9.21, a common theme in the numerical data mining tools is the search for items that influence a given fact variable. Much like the data cube, you might choose the Sales variable as the fact to be investigated. In statistics terms, it becomes the dependent variable. You then want the system to examine various attributes or independent variables to see how they influence the dependent variable. For instance, you might have data on customer location, income, product category, time and month purchased, marketing budget, and a host of other variables that could conceivably affect the level of sales. Remember this goal as you read the rest of this section. Even if you have limited experience with statistics, remember that most of the tools are trying to identify which independent variables strongly affect the dependent variable.

Correlation is a key statistical tool that is leveraged in data mining. A data mining system can compute the cross correlation for all dimensions. High correlations provide a useful indicator of how one dimension (variable) affects another. Correlation typically represents direct effects between pairs of variables. Multiple regression is an extension of correlation where multiple dimensions (independent variables) are used to predict values for a dependent variable. The regression coefficients have long been used by statisticians to measure the importance of each attribute. Special data mining tools extend these concepts into nonlinear relationships, automatically searching for relationships between variables. For example, marketers could mine the sales data to determine which variables had the strongest impact on sales revenue, including price, quality, advertising, packaging, or collections of product attributes. Regression tools provide numerical estimates of the coefficients for direct and indirect effects, along with measures of the accuracy of the estimate (standard errors).

Clustering is another data mining technique. It tries to find groups of items that have similar attribute values. For example, a car manufacturer might find that younger buyers are attracted to one car model, while older buyers tend to pur-

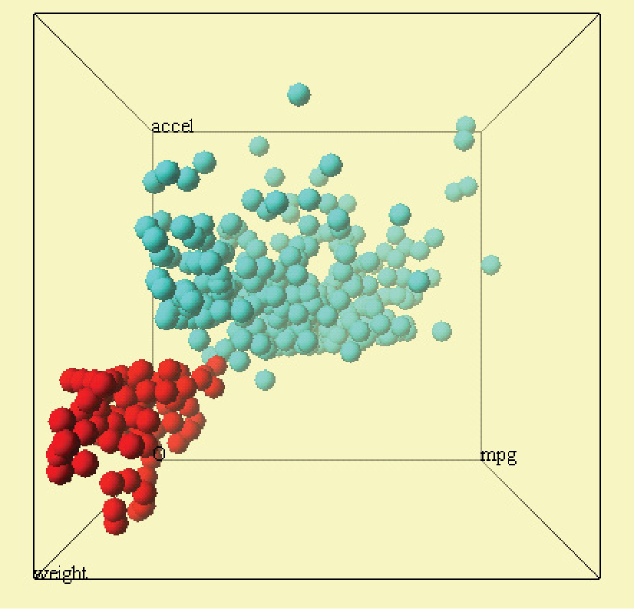


Figure 9.22

Clustering. Sometimes you want to know which items are similar to others. You might face distinct groups of customers, or your products might be perceived in certain clusters. This example compares cars in terms of three dimensions (acceleration time, weight, and gas mileage) to reveal two distinct groups.

chase a different model. These concepts are relatively easy to understand in two or three dimensions. The tools can search in higher dimensions, looking for groupings across dozens of attributes. The results are more difficult to interpret and act on, but can provide useful information in dealing with complex datasets. Figure 9.22 shows an example that compares cars on three dimensions: acceleration time, weight, and miles per gallon. The results show that there were two distinct groups of cars at that point in time. Heavy cars with low acceleration times (faster), and low miles per gallon versus light, slow cars that achieved more miles per gallon.

Clustering is a useful tool when you are first looking at data or when you need to reduce the number of dimensions. In the car example, you can reduce the analysis to looking at those two groups of cars. Similarly, you might learn that you have three or four types of primary customers, enabling you to focus your analysis and decisions on how representatives from each group will react to changes.

One of the classic data mining tools is market basket analysis (or association rules). **Market basket analysis** was designed to address the question, What items do people tend to purchase together? Figure 9.23 shows the classic example that was purportedly identified by a convenience store. Managers found that on weekends, people often purchased both beer and diapers. This raises the immediate issue of how you can use the results. You might stock the items near each other to encourage people to buy both. Or, you might place the items at opposite ends of an aisle—forcing people to walk past the high-impulse items such as chips. Or, perhaps you discount the diapers to attract more customers and make up the additional profit by not discounting the beer. The tool is generic and is used by

Figure 9.23

Market basket analysis. What items do people buy together? Data mining tools can examine each purchase to identify relationships. You can use this information to increase cross selling.

companies such as Amazon.com and Netflix to show you books that were bought by other customers. If you are interested in the first book, you might also like the books that other people purchased along with that book. Tivo, the television recording system, uses a similar process to identify programs that you might be interested in watching. To illustrate the hazards of data mining, many people have reported interesting twists with Tivo. For instance, if you watch one movie for children, the system will begin to offer more shows geared toward children. Market basket or association analysis is relatively easy to compute—particularly for pairs of items. Several tools exist to perform the computations for you, including a couple of open source tools such as Weka.

Do not let the name fool you. Market basket analysis has many more uses than the example shows. More properly known as association analysis, it works well with categorical data that does not need to be measured numerically. It basically estimates the probability that any two (or more) items will occur together. These items could be purchases, or they could be diseases, events such as Web clicks, votes, and so on.

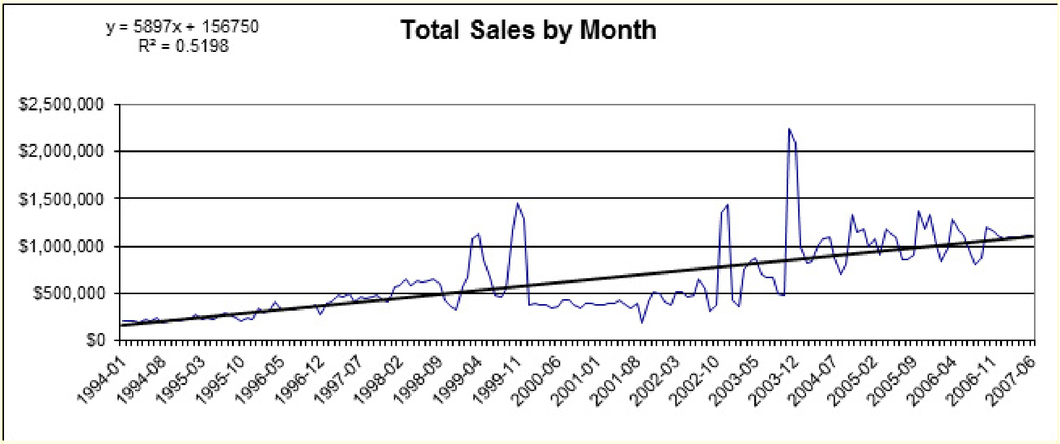
Several data mining tools have been built in the past few years. They are relatively easy to use, but you might want to review your statistics to help understand the results. One catch with the tools is that some of them can take time to run—even with fast machines, some complex analyses can take hours. For example, market basket analysis is relatively fast with pairs of items, but requires exponentially more computations and time if you attempt to compare more than two items at a time. A bigger problem is that the results might be meaningless or not reproducible. They might simply have arisen because of some random occurrence in the data. The bottom line is that you have to carefully evaluate each piece of information to make sure it is relevant and important.

Expert Systems

Can information technology be more intelligent? Can it analyze data and evaluate rules? Imagine your life as a top-notch manager. Coworkers perceive you as an expert and value your advice and problem-solving skills. You are constantly answering questions and there are always more problems than you can handle. You are using decision support systems and integrated information technology to perform your job better and more efficiently, but it is

Technology Toolbox: Forecasting a Trend

Problem: You need a basic forecast of sales data.
Tools: Many statistical tools and packages exist to build models and estimate trends. The simplest technique is a linear regression. Excel has tools to calculate and display the results.



Open the Rolling Thunder database and create a query that computes the total sales by year and month. The Format function converts the date: Format(OrderDate, "yyyy-mm"). Save this query within Access, and close the database. To import the data into Excel, open a new worksheet and choose the Data/Import/New Database Query option. This approach will build a dynamic link to the query.

Create a line chart of the data. Right-click the plotted line and select the option to add a trend line. You should stick with the linear trend, but you might want to test the other choices. Select the options to display the equation on the chart.

To see the actual forecast values, select the entire column of data for SumOfSalePrice, but do not include the title row. Scroll down to the last row in the series and find the small square handle on the lower-right-side corner. Drag this handle to extend the series for six months. Add the appropriate months in the month column. Edit the chart and edit the series selections to include the new rows. Notice that the new points fall exactly on the trend line.

Excel includes more powerful statistical tools, including one that performs multiple regression when you want to examine the effect of many variables. Although this dataset contains only one variable, you can still use it to test the tool. First, insert a new column that numbers the months as 1, 2, 3, and so on. Ensure the Analysis ToolPak is loaded and select Tools/Data Analysis and pick the Regression tool. As the Y range, select the sales column including the title row but excluding the six rows you forecast earlier. Select the month column as the X range. Be sure to check the Labels box, and then run the regression. This tool provides the standard regression coefficients, probabilities, and diagnostics.

Quick Quiz:

1. Why is a linear forecast usually safer than nonlinear?
2. Why do you need to create a new column with month numbers for regression instead of using the formatted year-month column?
3. What happens to the trend line r-squared value on the chart when you add the new forecast rows to the chart?

not enough. Can technology help you with more complex decisions and problem solving? From another perspective, when you encounter new problems with different, complex models, it would be helpful to have an expert assist you with applying and understanding the models. Yet experts or consultants are expensive and not always available. Can you somehow capture the knowledge and methods of experts and use technology to make this knowledge available to workers throughout the company?

Specialized Problems

Expert systems have proven useful for many problems. The goal of an expert system is to enable novices to achieve results similar to those of an expert. The users need to understand the basic problem, learn the terminology, and be able to answer questions. For example, a typical patient would not be able to use a medical expert system because the questions and terms would not make any sense.

Think of an expert system as a consultant in a box. The consultant can solve only certain specific problems. For example, perhaps a retail store manager needs to estimate buying patterns for the next few months. The manager might call a marketing consultant to survey buyers and statistically search for patterns. The consultant will ask questions to determine the basic objectives and identify problems. Similarly, a production manager might be having problems with a certain machine. The manager might call a support line or a repair technician. The advice in this situation will be quite different from the marketing example, because the topics (or domains) of the two problems are different. It would be difficult to create one computer program that could help you with both types of problems. On the other hand, there are similarities in the approach to the two problems. Computerized expert systems are designed to solve narrow, specialized problems. Each problem can be relatively complex, but it must be reasonably well defined. Many business problems fall into this category, and expert systems can be built for each problem.

Diagnostic Problems

Several problems in the world can be classified as diagnostic situations. These problems arise when the decision maker is presented with a set of symptoms and is asked to find the cause of the problem, as well as solutions. Consider a firm that uses a complex machine. If the machine breaks down, production stops until it is fixed. In addition, maintenance tasks have to be performed every day to keep the machine running. The company hires an engineer to perform these tasks. The engineer also knows which adjustments to make if various symptoms appear. This system has been working well, and the company wishes to expand to other locations with a franchise system. The problem is that there is only one engineer, and it would be too expensive to have a highly trained engineer at each location.

One possible solution would be to set up a phone link between the franchises and the engineer. One person at each franchise would be trained in the basics of the machine. If problems arise, the person could call the engineer. The engineer would ask specific questions, such as "What do the gauges show?" The answers will lead the engineer to ask other questions. Eventually, the engineer makes recommendations based on the answers.

Of course, if there are many franchises, the engineer will be too busy to solve all of the problems. Also, if the businesses are located in different countries, the time differences may not allow everyone enough access to the engineer. A bet-

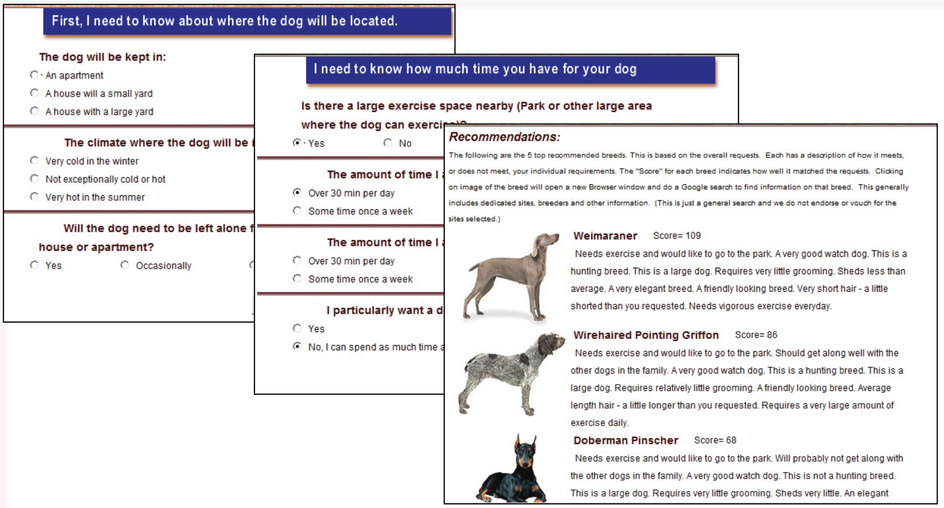


Figure 9.24

Expert System example from ExSys. This sample expert system acts as a knowledgeable dog lover and asks questions about how you view characteristics of dogs. Based on your responses it makes a recommendation of which breed might be good for you. The Web site contains many other examples.

ter solution is to create a computerized expert system. All the expert's questions, recommendations, and rules can be entered into a computer system that is distributed to each franchise. If there is a problem, the on-site person turns to the expert system. The system asks the same questions that the engineer would and arrives at the same recommendations.

As shown in Figure 9.24, expert systems also have the ability to explain their recommendations. In more complex examples, while running the ES, the user can ask it to explain why it asked a particular question or why it arrived at some conclusion. The ES traces through the answers it was given and explains its reasoning. This ability helps the user gain confidence in the decisions, allows mistakes to be corrected, and helps the users remember the answer for future reference.

The business world offers many examples of diagnostic situations, such as identifying causes of defects, finding the source of delays, and keeping complex equipment running. The common characteristic is that you are faced with a set of symptoms, and you need to find the cause.

Speedy Decisions

Other situations can benefit from the use of expert systems. Even if a problem is not exceedingly complex, you could use an expert system to provide faster responses or to provide more consistent recommendations. Several advantages can be gained from making decisions faster than your competitors do. If you can identify a trend in stock prices before anyone else, you can make a higher profit. If you can answer customer questions faster, they will be more likely to shop with you in the future. If you can provide a loan to a customer sooner than anyone else, you will do more business.

Transaction-processing systems keep much of the basic data that you need to make decisions. Decision support systems help you analyze that raw data. Both of these tools enable you to make decisions faster than trying to make the decision without any computers. However, it still takes time for a human to analyze all of the information.

Consider the case of a bank loan. In order to get a loan, you go to the bank and fill out a loan application form. You tell the loan officer why you want the loan and provide basic data on income and expenses. Depending on the amount of money involved, the banker will probably check your credit history, get appraisals on any collateral, and perhaps get approval by a review officer or loan committee. All of these actions take time.

Now, consider the steps involved with a computerized process. First, you need to tell the bank that you want a loan. Instead of driving to the bank, you could use the telephone. With a push-button phone, you enter information directly into the bank's computer. The computer would give you a choice of loan types (car, boat, personal, etc.), and you push a button to select one. You enter the amount of money you want to borrow. The next step is to check your credit history. Your income, expenses, and credit record are available to the bank from national credit reporting agencies. The bank might also have its own database. The bank's computer could be connected to credit agency computers to collect additional data on your credit history.

To make the final decision, the bank needs a set of rules. These rules take into account the size of the loan, the value of the collateral, as well as your income, expenses, credit history, and existing loans. When the bank has determined the proper rules, the computer performs the analyses. If the bankers trust the rules, the computer could make the final decision. For example, there would be no need for a loan officer to be involved in simple decisions, such as making small car loans to customers with large savings accounts. With an expert system, a bank can cut the loan-approval period down to a few minutes on the phone.

Many other decisions need to be made rapidly. The first step in all of these cases is to make sure that the transaction-processing system provides the necessary raw data. The second step is to create a set of rules for making the decision. The difficulty lies in finding these rules. For some problems, there are well-defined rules that can be trusted. For other problems, the rules may not exist. In this case, the company will probably still need a human to make the final decision.

Consistency

The example of the bank loan demonstrates another advantage of expert systems. Business decisions are subject to a wide variety of nondiscrimination laws. An expert system can be used to provide consistent decisions. The rules followed by the ES can be set up to avoid illegal discrimination. Businesses also have credit ratings, which are often determined by Credit Clearing House (CCH). CCH uses an expert system to make the "easy" decisions, which speeds up the process by allowing humans to focus on the more complicated cases. It also leads to consistent application of the rules.

Consider the loan example. If each loan officer makes individual decisions, it is hard to determine whether they are consistent with corporate policy. Each individual decision would have to be checked to make sure it was nondiscriminatory. On the other hand, a committee could spend several weeks creating a set of lending rules that can be verified to be sure they are legal and ethical. As long as the bank

Reality Bytes: Don't Bet Against the Machine

Online poker sites are hot. Many people, particularly college students, see it as a simple diversion or a way to pick up a couple of bucks. But have you considered how easy it is for someone to cheat at online poker? Some of the better gaming sites try to detect obvious cheats, but it can be hard to catch a group of players who work together to fleece an outsider. Players also face a new threat: poker bots—automated programs that play poker. Some people are aboveboard and build them to search for new ideas in AI. There is even an international competition for poker bots. Others build poker bots and put them online without telling opponents. But how good are the poker bots? Dr. Jonathan Schaeffer, a professor of computer science at the University of Alberta, has spent over 14 years developing a poker bot, and he competes aboveboard in public tournaments. In 2003, his program went head-to-head against a top poker player. For the first 4,000 hands, the computer was leading, but the poker player eventually analyzed the program's approach and developed a new strategy to beat it. But how many poker games involve top-level players? Dr. Schaeffer observed that "when you look at the low-limit tables, I have not doubt that there are computer programs that can win at that level consistently. And don't forget that these programs can play all the time, without getting tired. And they can play at multiple tables." In 2005, the Golden Palace in Las Vegas sponsored a poker bot competition. Poker ProBot created by Hilton Givens of Lafayette, IN won after nearly 5,000 hands, earning the $100,000 prize. He also had the opportunity to match his program against human pro player Phil Laak. Phil trounced the machine in 399 hands, and also beat the University of Alerta's PokiX bot in 290 hands. But most experts believe that just as in the chess world, the machines will eventually improve to beat humans. In 2011, the U.S. government shut down most of the online poker sites doing business America--primarily because they allegedly violated the U.S.laws against online gambling. Ultimately, online poker is a fool's game.

Adapted from Shawn P. Roarke, "Bots Now Battle Humans for Poker Supremacy," *Fox Sports*, July 20, 2005.

employees follow the recommendations of the ES, the outcome should not be discriminatory. Because there should be few cases where the loan officer overrules the ES, managers will have more time to examine each of these circumstances.

Many business decisions need to be performed consistently to avoid bias and to treat people equally. Loans, pricing, raises, and promotions are some examples. However, there can be problems with using a computer system to enforce standards. The main difficulty lies in creating a set of rules that accurately describe the decisions and standards. For example, it might be useful to have a set of rules regarding raises and promotions, but think about what happens if an employee's job does not fit the basic rules. Organizations continually change, which means the rules have to be monitored and changed regularly.

Training

Training employees is closely associated with problems of consistency. All organizations must train employees. If the tasks are complex and the decisions highly unstructured, it can take years for employees to learn the rules and gain the experience needed to deal with problems. Two features of expert systems help employ-

First, compute the monthly income before taxes.
Next, compute the monthly payment of the loan.
If the payment is greater than 5% of income:
Compute total of other loans payments.
Compute payments as percent of monthly income.
 If this percent is less than 25%:
  If the new loan is less than 10%, make loan.
   Else:
    If total monthly expenses are less than 40% of income, make the loan.
    Else:
     If less than 50% and has been a customer for more than 5 years or if less than 60% and has been a customer for 10 years and has lived at the same address for 5 years, make the loan.

Figure 9.25

Sample rules for the bank loan. A portion of the business rules that are used to determine whether a person should get a loan.

ees learn. First, employees learn what questions need to be asked. In particular, after using the system for a while, certain groups of questions will occur together. Second, most expert systems have provisions for explaining their answers (and the motivation for each question). At any point, an employee can ask the expert system why it asked a certain question or why it reached a conclusion.

Building Expert Systems

How do you create an expert system? At first glance, you would suspect that expert systems are hard to create. However, except for one step, which is hard, tools exist to make the job easier. The area that causes the most problems when you are creating expert systems is finding a cooperative expert who fully understands and can explain the problem. Some problems are so complex that it is difficult to explain the reasoning process. Sometimes the expert may rely on vague descriptions and minor nuances that cannot be written down. Even though expert systems can deal with these types of problems, it might take too long to determine the entire process. Also, if you transfer the expert's knowledge to a computer, the expert might worry about losing his or her job.

Most expert systems are built as a knowledge base that is processed or analyzed by an inference engine. A **knowledge base** consists of basic data and a set of rules. In most situations, an inference engine applies new observations to the knowledge base and analyzes the rules to reach a conclusion.

The basic steps to create an expert system are (1) analyze the situation and identify needed data and possible outcomes, (2) determine relationships between data and rules that are followed in making the decision, (3) enter the data and rules into an expert system shell, and (4) design questions and responses. A **knowledge engineer** is often hired to organize the data, help devise the rules, and enter the criteria into the expert system shell, or supervise programmers as they create an expert system.

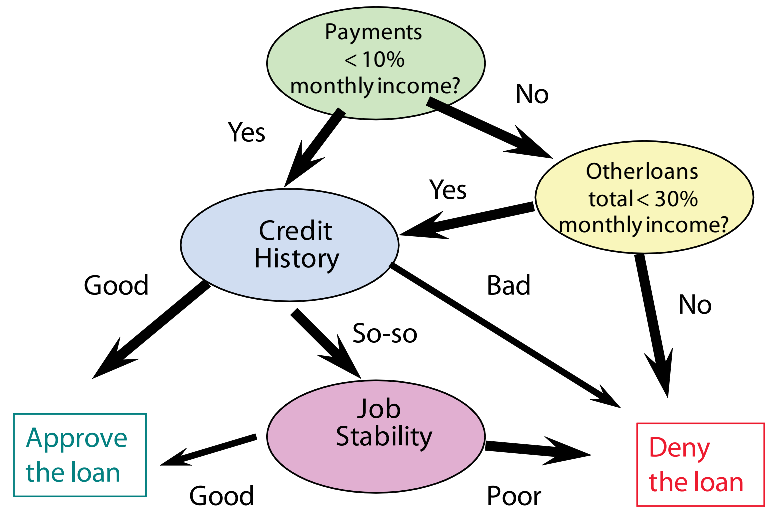


Figure 9.26

Decision tree for sample bank loan expert system. Parts of a knowledge base are often expressed as a decision tree. Each answer to a question leads to additional questions and eventually to a decision. Notice that questions sometimes require numeric answers but can also rely on subjective comments.

Knowledge Base

A knowledge base is more than a simple database. It consists of data but also contains rules, logic, and links among data elements. In most cases, it contains less structured and more descriptive data. For example, an ES for medicine might have a list of symptoms that contains items like "high temperature" and "intense muscle pain." This knowledge base is the reason why the problem must be narrow in scope. Even narrow, well-defined problems can require large amounts of information and thousands of rules or relationships. The real challenge in building expert systems is to devise the knowledge base with its associated rules.

Three basic types of expert systems are in use today. They are defined by how the knowledge base is organized: by rules, frames, or cases.

Rules

The heart of a rule-based ES is a set of logical rules. These **rules** are often complicated. Consider some of the rules that might be needed for an ES to evaluate bank loans, as shown in Figure 9.25. This example has been simplified to keep it short. There will usually be hundreds of rules or conditions to cover a wide variety of situations. Rules are often presented as IF… THEN… ELSE … statements. They can include Boolean conjunctions such as AND, OR, NOT. Figure 9.26 presents a portion of a **decision tree** that visually displays the rules.

The difficulty with any ES lies in determining these rules. Some of them will be easy. Others will be complex. Most of them will come from the expert. Unfortunately, most people do not usually express their thoughts in the form of these rules. Although a person might follow rules of this sort, they can be difficult to express. It is even more difficult to remember all the rules at one time. For instance,

Welcome to the Loan Evaluation System.
What is the purpose of the loan? car
How much money will be loaned? 15,000
For how many years? 5

The current interest rate is 10%.
The payment will be $297.02 per month.

What is the annual income? 24,000

What is the total monthly payments of other loans?
Why?

Because the payment is more than 10% of the monthly income.
What is the total monthly payments of other loans?
50.00

The loan should be approved, because there is only a 2% chance of default.

Figure 9.27

Bank loan sample screen. An expert system carries on a dialogue with the user. The ES asks questions and uses the answers to ask additional questions. The user can ask the ES to explain a decision or a question. Hence the ES can be used for training purposes.

say you have lived in the same place for five years and a new person moves into the neighborhood. She asks you to describe the best ways to get to school, the mall, and the grocery store. Then she asks you for the best shortcuts if one of the roads is closed. This problem is relatively simple, but can you sit down right now and provide a complete list of all the rules?

Creating an ES

More commonly today, an ES is built from an expert system shell. This program provides a way to collect data, enter rules, talk to users, present results, and evaluate the rules. To create an ES, you must know what data you need and all of the rules. Once you express this knowledge base in the format used by the shell's inference engine, the shell takes care of the other problems. Many ES shells are available on a wide variety of computers; Jess and Clips are two common systems that are available free or at relatively low cost.

To understand how to create an ES, consider the bank loan example. A typical dialogue with the user (the loan clerk) appears in Figure 9.27. Notice that the ES begins by asking some basic information-gathering questions. The responses of the user are underlined. Once the basic data is collected, the ES performs some computations and follows the built-in rules. Notice that the ES follows the rule that asks for the other loan payments. However, the loan clerk does not know about this rule, so he or she asks for clarification. This ability to ask questions is a powerful feature of expert systems.

Reality Bytes: One Smart Machine is Better than Thousands of People

Many people have touted the potential benefits of crowd-sourcing: breaking a problem into small pieces and using the Internet to assign each piece to thousands of workers. Amazon developed the Mechanical Turk to facilitate these types of tasks. Anyone can sign up to complete tasks and receive wages—often only pennies a chore. The goal is to handle tasks that are easy for humans but difficult for machines. The problem is that people being paid low wages are usually not very good and machines are getting smarter. The Web site Yelp ran a comparison test. First, researchers developed a multiple choice test to try to identify the best Turkers who could correctly categorize a business (restaurant, clothing, etc.), phone number, and address; based on its Web site. The initial test was given to 4,660 applicants, only 79 of them passed. This select group of the "best" were then given the problem of classifying business information where three people saw the same site. If a majority (2-3) agreed, the site was then classified. The researchers then applied a Naïve Bayes classifier data mining algorithm on the same set of problems. The algorithm was trained using 12 million examples submitted earlier by Yelp users. The computer algorithm easily beat the humans—correctly classifying the sites a third more often than the people. Does that mean machines are smarter than humans? Or just better than poorly-paid humans with low motivation?

Adapted from Christopher Mims, "AI Defeats the Hivemind," *Technology Review*, December 20, 2010.

Once you have collected all of the rules involved in the problem, you enter them into the ES shell. The shell lets you type in the questions you want to ask the user. You define the calculations and tell the shell how to look up any other information you need (e.g., the interest rates for auto loans). You then enter the conditions that tell the shell what questions to ask next. If there are many rules with complex interactions, it is more difficult to enter the rules into the shell. One advantage of ES shells is that you generally have to enter only the basic rules and data. As the user enters the data, the shell performs the calculations and follows the rules. The shell also automatically answers the user questions. You do not have to be a computer programmer to create an ES with a shell. With training, many users can create their own expert systems using a shell. However, there are many dangers inherent in ES development, so it helps to have someone evaluate and test the resulting system.

Limitations of Expert Systems

Expert systems are useful tools that can be applied to several specialized problems. However, several important drawbacks arise in their design and use. First, they can be created only for specific, narrowly defined problems. Some complex problems contain too many rules with too many interactions. It quickly becomes impossible to express all of the interrelationships. For example, it is currently impossible to create a medical diagnostic system that covers all possible diseases. However, smaller systems are in use that help determine drug dosages and other treatments such as radiation levels for cancer patients.

Another problem that users and designers have encountered is that it can be difficult to modify the knowledge base in an expert system. As the environment or problem changes, the expert system needs to be updated. The changes are relatively easy to make if they affect only a few rules. However, many expert systems use hundreds of interrelated rules. It is not always clear which rules need to be altered, and changes to one rule can affect many of the others. In essence, as the situation changes, the company is forced to completely redesign the expert system. In fast-changing industries, it would cost too much to continually redesign an expert system. In the lending example, a policy change based on monthly income would be relatively easy to implement. On the other hand, some changes in policy would force a complete redesign of the expert system. For instance, a bank might decide to grant loans to almost everyone but charge riskier people higher interest rates.

Probably the greatest difficulty in creating an expert system is determining the logic rules or frames that will lead to the proper conclusions. It requires finding an expert who understands the process and can express the rules in a form that can be used by the expert system.

Management Issues of Expert Systems

Creating and building an expert system involve many of the same issues encountered in building any other information system. For instance, the problem must be well defined, the designers must communicate with the users, and management and financial controls must be in place to evaluate and control the project.

However, expert systems raise additional management issues. Two issues are particularly important: (1) if an expert transfers knowledge to an expert system, is there still a need for the expert; and (2) what happens when the expert system encounters an exception that it was not designed to solve?

The answer to the first question depends on the individual situation. In cases where the problem is relatively stable over time, it is possible to transfer expert knowledge to software—enabling the firm to reduce the number of experts needed. If this action results in layoffs, the experts will need additional incentives to cooperate with the development of the system. In other cases, the firm will continue to need the services of the experts, to make changes to the ES and to solve new problems. Before starting an ES project, managers need to determine which situation applies and negotiate appropriately with the experts.

The second problem can be more difficult to identify. Consider what happens when workers rely on an expert system to make decisions, and management then cuts costs by hiring less-skilled workers. The new workers do not understand the system or the procedures—they simply follow decisions made by the rules in the ES. If an exception arises, the ES may not know how to respond or it may respond inappropriately. A customer then would be left to deal with an underskilled worker who does not understand the process and cannot resolve the problem.

Specialized Tools

Can machines be made even smarter? What technologies can be used to help managers? Research in artificial intelligence (AI) examined how humans are different from computers. This research led to tools that can be used for certain types of problems. Some of the ideas come from the early days of computers, but it has taken until now for machines to be developed that are fast enough to handle the sophisticated tasks. Ideas in AI have come from many disciplines, from biology to psychology to computer science and engineering.

Humans are noticeably better than computers in six broad areas: pattern recognition, performing multiple tasks at one time, movement, speech recognition, vision, and language comprehension. Some of these concepts are related, but they all represent features that would make machines much more useful. Even with current technological improvements, most observers agree that it will be several years before these features are available.

Pattern Recognition and Neural Networks

One of the early issues in AI research was the question of how human brains worked. Some people suggested that to make intelligent computers, the computers would have to work the same way as the human brain does. An important conclusion from this research is that humans are good at pattern recognition.

Humans use pattern recognition thousands of times a day. It enables people to recognize coworkers, to spot trends in data, to relate today's problems to last year's changes. Many problems in business could benefit from machines that can reliably recognize patterns. For example, what characteristics do "good" borrowers have in common? How will changes in the economy affect next year's sales? How are sales affected by management styles of the sales managers?

Pattern recognition is used by people to solve problems. It is one of the reasons teachers use cases to teach students to solve business problems. If you notice that a problem is similar to a case you have seen before, you can use your prior knowledge to solve the problem. Imagine how useful it would be if an expert system could recognize patterns automatically.

One current technique that is used to spot patterns is the use of neural networks. Initial study indicated that the brain is a collection of cells called *neurons* that have many connections to each other. Each of these cells is relatively simple, but there are approximately 100 million of them. In some respects, a neuron resembles a simple computer. It can be at rest (off), or it can fire a message (on). A neuron responds to other cells (input) to send messages to other neurons (output). A collection of these cells is called a **neural network**. Human neural cells are actually more complicated, but researchers have focused on this simplified form.

A common current example is a bank that uses a neural network to spot credit card fraud. In some cases, Mellon Bank's neural network identified fraudulent patterns even before the human investigators spotted them. It is faster and more accurate than an earlier expert system. The original expert system looked at a limited number of variables and indicated 1,000 suspects a day, which was far more than actually existed and too many for the investigators to keep up with. The new neural network system examines more variables, lists fewer false suspects, and adjusts its methods on its own.

A finance manager might use a form of pattern recognition to search for patterns in the financial markets to forecast future movements. Of course, with thousands of other people searching for patterns, the patterns would not last very long. Similarly, a banker might use pattern recognition to classify loan prospects.

Neural networks can be built with software. Also, computer chips are available today that function as neural networks. Neural networks can be measured in two ways by (1) the number of neurons and (2) the number of interconnections between the individual cells. It is fairly easy to increase the number of cells, but the number of possible interconnections increases very rapidly. For instance, if there are four cells, there are six possible connections. With 10 cells, there are 45 connections. With 1,000 cells, there are half a million connections. In general, if there are N cells, there are $N(N - 1)/2$ possible connections. For many purposes, not every connection is needed, but with millions of cells, a neural network would

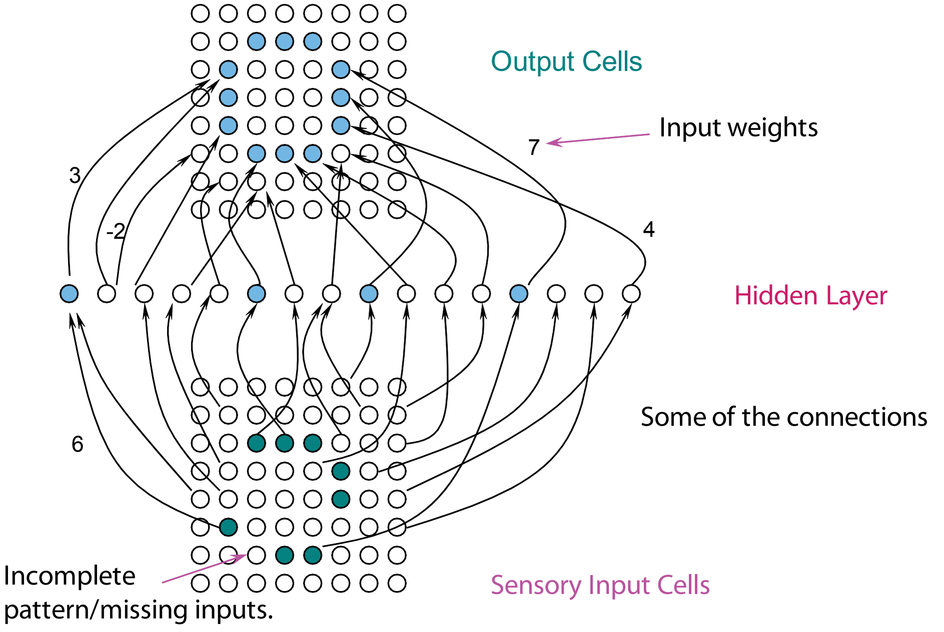


Figure 9.28

Neural net for pattern matching. Input cells convert data to binary form. The required hidden layer recodes the inputs into a new internal representation. The connections represent outputs from the lower layers. When total input levels exceed some value, the receiving cell fires. Any cell can be connected to many other cells. Input weights are determined by training. The output cells are triggered when total input levels from the connections exceed some threshold. Note that a pattern can be recognized even if some input cells are wrong or not firing.

incorporate a large number of connections. Most existing networks use only a few thousand cells.

Figure 9.28 presents a version of how a neural network converts an array of input sensors into a hidden layer and then stores patterns on an output layer. One useful feature of the neural network approach is that it is fairly good at identifying patterns even if some of the inputs are missing.

What can neural networks do that cannot be done with traditional computers? The basic answer is "nothing." However, they provide a new way of thinking about problems. More important, with hardware specifically designed to process neural networks, some difficult problems can be solved faster than with traditional computers. The primary objective of neural networks is the ability to store and recognize patterns. A well-designed network is capable of identifying patterns (such as faces or sounds) even if some of the data is missing or altered.

Another advantage that researchers hope to achieve with neural networks is the ability to simplify training of the computer. The discussion of expert systems noted that changes in the business often mean that knowledge engineers have to redesign the entire expert system. A neural network has a limited ability to "learn" by examining past data. Feeding it proper examples establishes the interconnection weights that enable the network to identify patterns. In theory, neural networks

Reality Bytes: Make the Trains Run on Time

Scheduling trains, planes, or healthcare appointments might appear to be an easy problem. Just figure out the capacity, compute the time needed to get from point A to point B, and then route everything. But, the problem is much more complex. To start with, a complete routing scheme is a difficult problem even in computer science, with no simple solution. But, it gets considerably worse when things go wrong—such as a train delayed by weather. A slowdown at one point can interfere with many other schedules. However, a university research project called Arrival resulted in new scheduling software that efficiently routes trains, even when disruptions happen. The system can handle almost instantaneous rescheduling as disruptions arise. It adjusts timetables, platform allocations, and staff scheduling. The system has been tested in the Netherlands, Germany, and Switzerland. In Berlin, the average wait time was cut in half from four minutes to two. In a test in Italy, the system created a 25 percent reduction in train delays in Palermo and Genoa.

Adapted from *Daily Mail Reporter*, "Brussels: We Can Make the Trains Run on Time," July 16, 2010.

have the ability to learn on their own. In practice, the learning stage is the most difficult component of building a neural network. Most times the designer has to understand the problem and provide hints to the network, along with good sample data. In many ways, training a neural network uses basic properties of statistics related to data sampling and regression.

Machine Vision

Machine vision has many uses in manufacturing environments. Machines are used in optical character recognition, welding and assembly, and quality control. Mechanical sensors have several advantages over humans. They do not suffer from fatigue, they can examine a broader spectrum of light (including ultraviolet and infrared), and they can quickly focus at many different levels (including microscopic).

On the other hand, traditional computer systems are literal in their vision. It is hard for computers to compare objects of different sizes or to match mirror images. It is hard for machines to determine whether differences between objects are minor and should be ignored or if they are major distinguishing features.

Say you are shown a picture of your instructor, and someone adds or subtracts features to it, such as bigger eyebrows, longer hair, or glasses. In most cases, you would still recognize the face. Computers would have difficulty with that problem because they see pictures as a collection of dots (or lines). How does the computer know which changes are important and which are minor?

Machine vision systems are improving rapidly but still have a way to go to become commonplace. For example, companies are working on applications in facial recognition and facial expressions, body tracking (so you can use your hand as a computer pointer), visual tracking of handwriting for use in computer tablets, product inspections for defects, and shape identification.

See what happens when you give a computer the first set of instructions, but it does not hear the commas correctly and thinks you said the second line:

(1) Copy the red, file the blue, delete the yellow mark.

(2) Copy the red file, the blue delete, the yellow mark.

Consider the following sentence, which can be interpreted by humans, but would not make much sense to a computer that tries to interpret it literally.
I saw the Grand Canyon flying to New York.

Or the phrase epitomized in a grammar book:
The panda enters a bar, eats, shoots, and leaves.

Figure 9.29

There are inherent problems with voice recognition. Punctuation and implicit meaning are two difficult areas. Even communication between people has frequent misinterpretations.

Language Comprehension and Translation

Related to voice recognition is the issue of language comprehension, or the ability of the computer to actually understand what we are saying. Technically the two topics are separate, since it might be possible to have a machine understand what we type onto a keyboard. Language comprehension exists when the machine actually understands what we mean. One test of comprehension would be the ability of the computer to carry on a conversation. In fact, Alan Turing, a British pioneer in the computer field, suggested the **Turing test** for computer intelligence. In this test, a human judge communicates with a machine and another person in a separate room. If the judge cannot determine which user is the machine and which is a person, the machine should be considered to be intelligent. Some people have tested this concept (using specific topics). Other people have noted that perhaps you do not have to be intelligent to carry on a conversation.

The Loebner Prize is a Turing test that runs every year to evaluate how close programs are coming to meeting the challenge. Several of the challengers have set up Web sites (e.g., www.alicebot.org, and www.jabberwacky.com) so you can play with these conversational bots. Why do you care? First, you can buy this technology to use it in business applications—such as building Web sites that answer basic questions from customers. Second, as a customer, you might want to learn to recognize when you are dealing with a machine instead of a human.

Language comprehension would be useful because it would make it easier for humans to use computers. Instead of needing to learn a language such as SQL to access data, imagine being able to get answers to questions asked in English (or some other **natural language**). Of course, any natural language has its limitations. The greatest danger with language comprehension is that the machine will interpret your question incorrectly and give you the “right” answer to the “wrong” question. Figure 9.29 provides a simple illustration of the complexities of language comprehension. The first example involves the use of punctuation. A misinterpretation of the command can result in deleting the wrong file. Similarly,

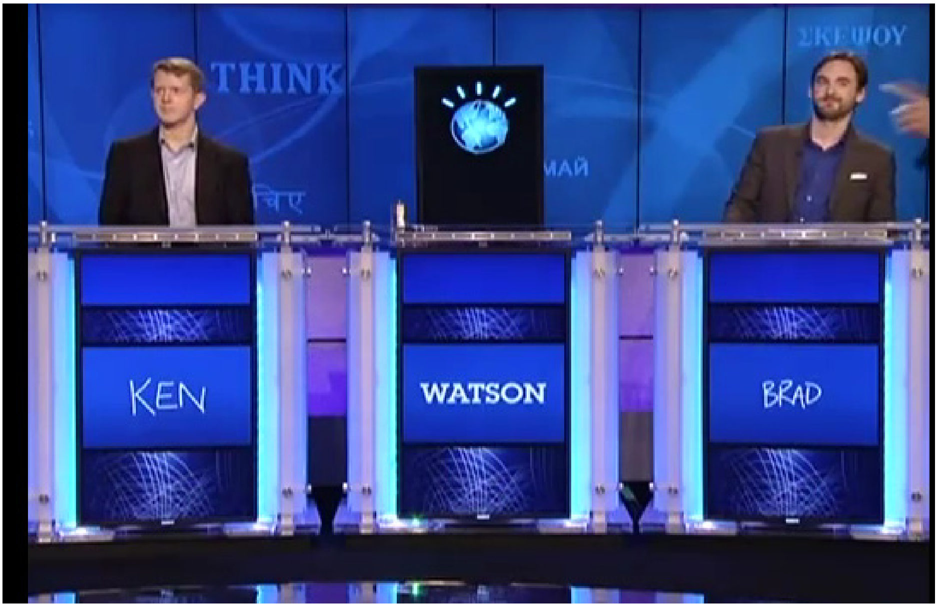


Figure 9.30

A practice Jeopardy match with IBM's Watson and two of the best human players. In three days of televised matches, Watson handily beat the humans.
Source: http://www.youtube.com/watch?v=12rNbGf2Wwo

interpretation of a natural language involves understanding some basic concepts, such as the fact that the Grand Canyon cannot fly.

Ultimately, translating languages requires an understanding of the underlying meaning of a sentence and paragraph. Early translation systems can convert a word from one language into another. For example, check out babel.altavista.com, or any of the other online translators. Some high-end translation systems have been developed that do a better job by at least recognizing common phrases and idioms. Yet even these systems need to be supplemented by human translators.

IBM raised the bar for natural language comprehension in 2011. The company created the Watson system designed to understand language, using statistics to help it understand questions and provide answers. As shown in Figure 9.30, to show off the system, it played several games of Jeopardy against two of the best human opponents. The Watson system won easily. The use of statistical analysis is still debated in computing circles. In language, it provides the benefit of letting the system decide not just an answer but how confident it is in the answer. Just as in real life, if a statement is not clearly understood, the computer can ask for clarification. IBM has suggested that the system can applied to many types of business and research problems, including medical research.

Robotics and Motion

Modern manufacturing relies heavily on robots, and the capabilities of robots continually increase. Most existing robots are specialized machines that perform a limited number of tasks, such as welding or painting. In many firms, there is little need for a general-purpose robot that can "do everything." However, one area that

Reality Bytes: Dealer Services Corp

Dealer Services Corp. provides financing to about 10,000 car dealers. The company essentially writes separate loans for every vehicle, providing individual conditions and payback schedules. The system generated huge amounts of data. Technically-oriented analysts within the company developed their own spreadsheets to analyze data, but they often had inconsistent or bad data. The company purchased WebFocus as a tool to provide centralized access to data and business intelligence. The system largely focused on interactive reporting and charting. When the recession hit in 2008 and 2009, the company managers were able to see results in individual markets and by dealers to see that inventory was not selling. CIO Chris Brady noted that these key insights warned the company early that the recession was going to cause severe problems. So the company tightened lending standards and increased financial reserves. It was also able to provide advice to dealers, such as "stop buying SUVs, they aren't selling." Brady also noted that "We definitely reduced our losses from bad loans and didn't start to see a negative effect until the very end of 2008."

Adapted from Elizabeth Horwitt, "Self-Service BI Catches On," *Computerworld*, December 13, 2010.

remains troublesome is the ability of machines to move. Making a machine that can navigate through an unknown or crowded space is especially difficult. Some work is being done in this area. Liability is a major problem when robots attempt to move among people.

In 2000, Honda built a humanoid robot (Asimo) in Japan. The Asimo robot has two legs and arms. Its most impressive feature is the ability to walk like a human, including up and down stairs. It can also shake hands and hand objects to people. The multi-million-dollar project is the latest step of a 16-year evolution.

In March 2004, DARPA held the first Grand Challenge contest for automated vehicles in the Mojave Desert. The challenge was to create an automated vehicle that could drive itself across 189 miles of desert hitting about 1,000 GPS waypoints in about 10 hours. The Carnegie Mellon $3 million Red Team vehicle (a modified Hummer) made it 7.4 miles. In fall 2005, the contest was run a second time—and five vehicles finished the 132-mile course. A huge gain in a year and a half, and the winning Stanford vehicle was created in less than a year! DARPA announced a new contest for November 2007, where the vehicles will have to drive through city traffic. Congress has mandated that 30 percent of Army vehicles be automated by 2015, and DARPA is attempting to stimulate innovation with these prizes.

As computer processors decline in size and price, it becomes easier to build intelligent mobile systems, making it possible to build robots and automated vehicles. Major automobile manufacturers are working on slightly less automated systems to provide assistance to drivers. For example, crash-warning sensors can automatically apply brakes for an inattentive driver. Slide-control systems to prevent spinouts on sharp turns have been installed in luxury vehicles for several years.

Reality Bytes: Guessing for Holiday Sales

Holiday shopping is critical for many U.S. businesses. At the high end, hobby, toy and game stores make 34 percent of their sales in November and December. Even for other retailers, the season is critical. Almost 20 percent of all retail sales value arises in the last two months of the year. Department stores hit 25 percent. The one sector that is lower than then one-sixth time frame is car dealers. The problem is that retailers need to order products and have them on the shelves well before the season begins. Consequently, retailers need good forecasts of both the expected sales level and details on which products are going to be hot.

Adapted from Phil Izzo, "Number of the Week: Outsize Importance of Holidays for Retailers," *The Wall Street Journal*, December 24, 2010.

Machine Intelligence

What would it take to convince you that a machine is intelligent? The Turing test has been proposed as one method. Many other tests have been proposed in the past. At one time, people suggested that a machine that could win at chess would be intelligent. Today's chess-playing computers have beaten even the top human players. Another test proposed was the ability to solve mathematical problems, in particular, the ability to write mathematical proofs. An early AI program created in the 1950s could do that. Today, for a few hundred dollars, you can buy programs or even small calculators that manipulate mathematical symbols to solve equations.

Some people have suggested that intelligence involves creativity. Creativity is probably as hard to measure as intelligence. Even so, examples of computer creativity abound. A few years ago, a programmer developed a system that created music. The interesting feature of the program was that it allowed people to call on the phone and vote on the music. The computer used this feedback to change its next composition. Not only was the computer creative, but it was learning and adapting, albeit in a limited context. Today, you can buy software that creates music or plays background to your solo.

Although business applications to much of this current research is somewhat limited, there are two main reasons for staying abreast of the capabilities. First, anything that makes the computer easier to use will make it more useful, and these techniques continue to improve. Second, you need to understand the current limitations to avoid costly mistakes.

DSS, ES, and AI

What are the differences between DSS, ES, and AI systems? The differences among decision support systems, expert systems, and artificial intelligence can be confusing at first. Take a simple problem and see how a computer system based on each method might operate. A common financial problem is to determine how much money to lend to customers. Any firm that grants terms to customers—not just financial institutions—must make this decision. Figure 9.31 discusses the differences among a DSS, ES, and AI approach to the inventory problem.

Decision Support System	**Expert System**	**AI/Nerual Network**
Loan Officer Data: Income Existing loans Credit report Model: Lend in all but the worst cases. Monitor for late and missing payments. Output: Name Loan #Late Amt Brown 25,000 5 1,250 Jones 62,500 1 135 Smith 83,000 3 2,435 …	ES Rules What is the monthly income? 3,000 What are the total monthly payments on other loans? 450 How long have they had the current job? 5 years … Should grant the loan since there is a 5% chance of default.	Determine Rules Data/Training Cases Loan 1 data…paid Loan 2 data… 5 late Loan 3 data… bankrupt Loan 4 data… 1 late Neural Network Weights Evaluate new data, make recommendations.

Figure 9.31

Comparison of techniques for a loan. A DSS can display background data for a loan officer and can also monitor customer payments. An ES could help managers decide if they should make the loan by evaluating more complex rules. An AI such as a neural network can analyze past loans and determine the rules that should be used to grant or deny future loans.

In a relatively simple system, the computer would retrieve data about the customer and the prior loans to that customer. Historically, loan officers used basic data and personal factors to make the lending decision. In some instances, these rules of thumb led to problems—with bad decisions and sometimes discrimination. The DSS could also be used to monitor existing loans and payments. As part of a transaction-processing system, it can notify managers when customers continually make late payments and help identify problem loans.

To improve consistency and reduce the decision time, many firms have moved to expert systems to help evaluate loans. Statistical analysis of prior loans is used to establish a set of rules that are coded into the ES. In some cases, the ES can then be operated with push-button phones or over the Internet. In straightforward cases, the ES can make the final decision and approve the loan. In more difficult situations, the preliminary results and data can be forwarded to a human loan officer to factor in personal judgment and factors not considered by the ES.

Of course, the value of the ES depends heavily on the accuracy of the underlying rules (and the supplied data). These rules might change over time or as economic conditions change. A neural network can be used to examine the prior loans automatically to identify the factors that predict successful and unsuccessful loans. Once these factors are identified, they can be coded into the ES to automate the decision process. In this situation, the AI/neural network takes the place of (or supplements) the decisions of the human expert.

The Importance of Intelligent Systems in e-Business

How can more intelligent systems benefit e-business? Disintermediation is a primary aspect of e-business. Businesses can interact directly with customers, with less need for middle levels such as retail stores. However, these middle levels often existed because they provided more explanations and support to customers. If you remove that level, how are you going to deal with thousands or millions of customers? If you have to hire hundreds of workers to answer customer questions, you will lose most of the potential benefits of disintermediation. One of the solutions to this problem is to implement more intelligent systems that can provide automated support to customers.

In many ways, the Internet adds complexity to the daily lives of customers and managers. The Internet provides access to huge amounts of data—and it is growing constantly. The growth adds more data, but it also means that the availability and use of information is constantly changing

Agents

A recent application of AI techniques has arisen in the context of the Internet. A key issue of the Internet is searching for data. Although the Internet dramatically improves communication, there are problems with maintaining the "interpretation" of the information from various systems. Originally, most data on the Web was stored as standard pages of text using HTML. Search engines would simply scan these pages and build searchable indexes.

Increasingly the Internet is being used to store and transmit objects composed of data, pictures, spreadsheets, sounds, and video. From a pure transmission standpoint, any object can be decomposed into raw data bits and sent between computers. Where we run into problems is searching for the objects. Consider a simple example where you want to find a new printer, so you search the Internet for prices. Today, many vendors store the product descriptions and prices in a database, and then build the HTML page on demand when you go to the site. Since the page is not static, the search engines do not index it.

One solution to this problem is to create software agents. **Agents** are object-oriented programs designed for networks that are written to perform specific tasks in response to user requests. The concept of object orientation is important because it means that agents know how to exchange object attributes, and they have the ability to activate object functions in other agents. The tasks could be simple, such as finding all files on a network that refer to a specific topic. One key feature of agents is that they are designed to communicate with each other. As long as your agent knows the abilities or functions of another agent, they can exchange messages and commands. General Magic was a pioneering company that created a standard programming language for agents. With this language, agents can transfer themselves and run on other computers. Agents also have a degree of "intelligence." They can be given relatively general commands, which the agents reinterpret and apply to each situation they encounter.

Consider an example illustrated by Figure 9.32. You have been working hard and decide to take a vacation. You want to go to a beach but do not have much money to spend. You are looking for a place where you can swim, scuba dive, and meet people at night. But you also want the place to have some secluded beaches where you can get away from the crowds and relax. You could call a travel agent and buy a package deal, but every agent you call just laughs and says that next

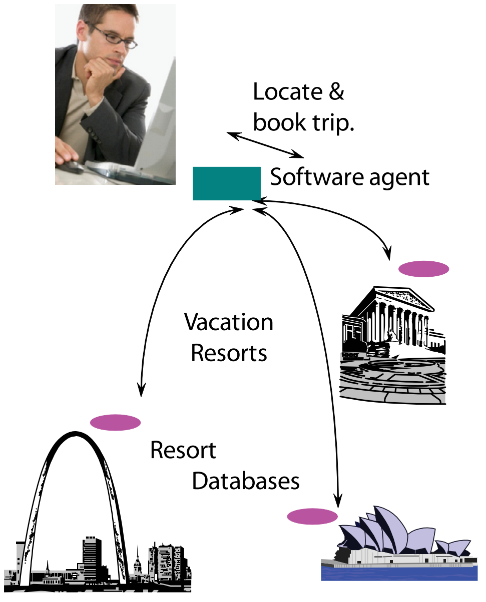


Figure 9.32

Software agents. A personal software agent might be used to book a vacation. It would take your initial preferences and communicate with other agents to find sites that matched your preferences. It might also be able to negotiate prices with competing resorts.

time you should call three months ahead of time instead of only three days ahead. You suspect that a beach resort probably has last-minute cancellations and you could get in, but how do you find out? Thousands of possibilities exit. If all of the resort computers had automatic reservation agents, the task would be fairly easy. You would start an agent on your computer and tell it the features you want. Your agent sends messages to all of the automated resort agents looking for open spots at places that matched your features. When your agent finds something close, it brings back details and pictures to display on your screen. When you decide on a resort, the agent automatically makes the reservations.

You might argue that some of the existing travel search sites come close to this example. On the surface, yes, sites such as PriceLine offer a few of the elements. However, the technology and methods beneath the surface are completely different and largely rely on humans to set prices. The travel industry is likely to be one of the first to incorporate these technologies—largely because many of the reservation systems are already linked together at some level. At some point, the negotiating agent needs access to the data. Today, these decisions are made at central search engine sites that have access to the data on millions of sites. In a true agent-based system, the search engine would not need direct access to the data, but would communicate with the agents located at each site.

Notice three important features of software agents. First, the agents need to know how to communicate. It is not as simple as transmitting raw data. They must understand the data and respond to questions. Second, imagine the amount of network traffic involved. In the vacation search example, your agent might have to contact thousands of other computers. Now picture what happens when a thousand other people do the same thing! Third, all of the agents are independent. You, as well as other computer owners, are free to create or modify your own agent. As long as there are standard methods for agents to exchange attributes and activate functions, they can be modified and improved. For instance, you might program your agent to weight the vacation spots according to some system, or you might teach it to begin its search in specific locations.

Programmers have begun to incorporate expert system and other AI capabilities into these agents. By adding a set of rules, the agent becomes more than just a simple search mechanism. The more complex the rules, the more "intelligent" it becomes, which means you have to do less work. In fact, software agents have the potential to dramatically increase the research in AI. Currently, because of limited standards and the difficulty of creating them, there are few examples of useful agents. As increasing numbers of people use agents and begin demanding more intelligence, it will become profitable for researchers to work harder at building reliable, intelligent software.

Support and Problem-Solving Applications

Increasingly, your customers want personalized attention to help in both selecting products and solving problems. Yet it is expensive to provide individual personal support to every customer. Instead, firms are developing expert systems and other intelligent applications to help customers with a more personalized touch. For example, look at Amazon.com's recommendation system. It began with books but has been expanded to most of their products. As you purchase items at Amazon.com, the system gives you a list of similar products that you might be interested in. For instance, if you purchase several science fiction books, it will suggest new releases of similar books. The system can increase sales because it helps show customers items that they might not have found otherwise.

More complex products can benefit from more sophisticated expert systems that help analyze customer needs and help configure the correct components. For example, a computer vendor could build a system that asks questions to help identify the applications that a customer will run. It could then suggest specific enhancements such as adding RAM or a second disk drive to improve performance.

Similarly, many firms are building expert systems to help customers with problems. If a customer has a problem installing a new product, he or she can turn to the Web site. The system asks questions to identify the problem and then make suggestions. The advantage of the expert system is that it is available 24 hours a day, can solve most of the easy problems, and is less embarrassing to customers who might think their questions are too "silly" to ask a human troubleshooter.

Intelligent systems can also be useful for B2B and other forms of e-business. The systems might analyze past purchases and suggest new products, or automatically analyze sales patterns and help managers develop new products and close out unprofitable lines. They can be used to develop automated ordering systems that predict customer demands, schedule production, and generate automated sales orders and payments.

It can be difficult to develop these applications, but firms that build powerful systems will attract customers and increase the level of sales to each customer. Ultimately, these systems could be the primary reason people switch to buying items over the Internet.

Cloud Computing

How can cloud computing be used to analyze data? Cloud computing offers some options for analytical tools—but the process is only beginning. Some decision tools require relatively large amounts of computation and storage capabilities. In some cases, these tools could be run on large parallel processing supercomputers. Some research institutions provide online access to supercomputers—but they are traditionally used for scientific research. For more typical business research, it should be possible to use multiple processor systems leased from cloud computing providers. Companies such as Amazon provide access to multiple processors based solely on the amount of time used. Consequently, researchers can develop algorithms, test procedures, and fine-tune the analysis. Then, when the main data sets are loaded, additional processors can be leased for a short time to process the main results. With minimal fixed costs, cloud computing makes it possible to tackle large problems at relatively low costs.

It is likely that companies will offer data analysis as package services through online systems. Currently, several market research firms will conduct studies, format data, and run analyses for other companies. As more data becomes accessible through online systems, it will become possible for cloud-based companies to offer direct access to analytical services. For instance, if you want to offer services similar to Amazon or Netflix to show customers similar items purchased by customers, a company could automatically read your sales data, perform the forecasts, and display the results using links across the Web. You would not have to develop the algorithms or purchase high-speed computers to handle the computations. On the other hand, you might have less control over customization or modification of the algorithms. Leased systems might not provide a competitive advantage, but they might make it easy for your company to add desirable features to your Web site at relatively low cost.

Summary

Managers make many different decisions. Every business discipline builds models to help people analyze problems and make decisions. Without models and tools, people rarely make good decisions. Many tools have been created to help you analyze data and make decisions. In many cases, you will want to build a data warehouse to retrieve and organize the data. You can build a DSS, building a model in a spreadsheet or more advanced statistical analysis tool. A good DSS extracts the needed data from the database, evaluates the model, and displays the results in a form that helps managers visualize the problem and quickly choose a solution. The biggest difficulty with DSS tools is that you generally need to be trained to create the models and understand the results.

More sophisticated data mining tools can be employed to semiautomatically search for correlations and other relationships within the data. Common regression, clustering, and classification tools use statistical measures to identify the importance of various attributes and to build forecast equations. Market basket analysis identifies items that customers purchase together. The information provided by this analysis is a powerful tool for cross selling related products. Data mining tools are powerful techniques, but the results are not always useful, and you must carefully evaluate the implications of the results to ensure that they are realistic and repeatable.

Expert systems provide a different level of decision automation. They analyze data based on rules defined by an expert. They can handle complex and missing data. They are particularly useful at helping novices reach a better decision. They are excellent tools for specialized, narrowly defined problems. The biggest concern arises when someone tries to build an ES for a problem that is too large, too variable, or unstructured. The ES is not likely to work, and it will cost money and time to build. Worse, the proposed decisions might be nonsensical.

Scientists are continually working on ways to automate even more decisions. Neural networks are incredible tools for analyzing pattern data. They have been successfully applied to problems ranging from speech recognition to lending analysis. You can purchase software that will quickly build a neural network to analyze data. One drawback to neural networks is that the relationships tend to be highly nonlinear and difficult to interpret. So, you might reach an answer, but you might not be able to explain the relationships. Other tools that are increasingly useful in business applications are machine vision, robotics, and language comprehension.

Automated tools can help you provide better service to customers and suppliers, particularly when the intelligent systems can be reached online. If you can help a customer solve a problem 24 hours a day without having to pay hundreds of humans, you can gain happier customers with little additional cost. Several companies are working on building intelligent agents that will enable customers and vendors to interact automatically by following rules that you specify.

A Manager's View

It is hard to make good decisions. You need fast access to huge amounts of data, the ability to evaluate various models, and a way to visualize the problem and the solution. Various levels of tools are available to help. The tools provide different types of intelligence and support. As a manager, you need to understand the context of the problem and know which tools can be applied to solve a problem. You also need to be enough of an expert to recognize when a system provides useless or bad answers so that you can avoid disasters.

Key Words

agent
artificial intelligence (AI)
data marts
data mining
data warehouse
decision support system (DSS)
decision tree
expert system
extraction, transformation, and loading (ETL)
geographic information system (GIS)
global positioning system (GPS)
knowledge base
knowledge engineer
market basket analysis
metadata
models
natural language
neural network
online analytical processing (OLAP)
optimization
parameters
prediction
rules
simulation
Turing test

Web Site References

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CLIPS (Started by NASA)	clipsrules.sourceforge.net
ExSys (Commercial)	www.exsys.com
International NeuralNetwork Society	www.inns.org
Jess (Java)	www.jessrules.com
Mathworks neural network toolbox	www.mathworks.com/products/neuralnet
Machine Vision	
CalTech	www.vision.caltech.edu
Carnegie Red Team	www.cs.cmu.edu/~red/Red
British Machine Vision	www.bmva.org

Review Questions

1. Why is it so important to build models and analyze data using a scientific process?
2. What is the purpose of a data warehouse?
3. How is an OLAP cube browser better than using queries?
4. What is the role of a manager in a DSS?
5. How is a GIS used to answer business questions?
6. How can data mining help you make better decisions and what are some of the primary techniques?
7. What is an expert system and what are the characteristics of the problems that it is designed to solve?
8. What tools are available to help businesses construct expert systems and what features do they provide?

9. What types of problems are best suited for a neural network?
10. How would a fully autonomous vehicle alter business?
11. What are the differences between a DSS, ES, and AI features?
12. Why are intelligent systems so important for e-business?
13. How could cloud-based computing and the Internet be used to add intelligence to business applications and decisions?

Exercises

1. Work through at least two of the examples on the Exsys Web site. What features do the two examples have in common? Give an example (unrelated to any on the Web site) of a business problem or something from your life that could benefit from an expert system.
2. An HR manager wants to develop an expert system to evaluate potential employees applying to work for a job in your department. Assuming the job can be performed by a business-school intern, list some of the questions you would ask potential employees. Create a decision tree to evaluate the basic questions. Try to generate three possible outcomes: acceptable, unacceptable, and personal interview to decide. Your goal is to reduce the number of people needing a personal interview.
3. Interview an expert in some area and create an initial set of rules that you could use for an expert system. If you cannot find a cooperative expert, try researching one of the following topics in your library: fruit tree propagation and pruning (what trees are needed for cross-pollination, what varieties grow best in each region, what fertilizers are needed, when they should be pruned); requirements or qualifications for public assistance or some other governmental program (check government documents); legal requirements to determine whether a contract is in effect (check books on business law).
4. Describe how you could use data mining tools to help you find a new vehicle to buy. How well do the car-buying sites such as Edmunds perform these tasks for you?
5. Obtain an expert system (e.g., Jess and CLIPS are free). Create a set of rules to evaluate a simple request for a car loan. If you do not have access to the tool, at least build the decision tree.
6. Identify a problem that would be well suited for a neural network. Explain how the system would be trained (e.g., what existing data can be used?). Explain why you think the problem needs a neural network and what benefits can be gained.
7. For the following problems identify those that would be best suited for an expert system, decision support system, or a more advanced AI system. Explain why.
   a. A financial manager in a bank wants to find the best investments for her clients.
   b. A venture capital investor wants a system to do a first-pass evaluation of new business plans that are submitted via a Web site.

c. A plant manager wants to be able to forecast when equipment will need special maintenance. Currently, the engineers use a fixed schedule, but some products and operations seem to cause more problems than others.

d. A fast-food restaurant chain wants to help managers determine the appropriate number of employees to schedule for each day in the year.

e. A cell-phone provider wants an application on its Web site to help customers select a cell phone that best meets their needs.

f. A company has to select a city to host a new factory which happens about once a decade.

g. A marketing department wants an application to help them set the best prices for new products in different markets.

8. Examine existing travel sites, including aggregators such as Kayak.com. What features could be added to increase the intelligence level to assist consumers?

9. Use a spreadsheet to create the example from the Human Resources Management example. Fill in the market adjustment column so that raises match the performance appraisals. Remember, total raises cannot exceed $10,000.

DeptStor.mdb

You are a midlevel manager for a small department store. You have collected a large amount of data on sales for 2012. Your transaction system kept track of every sale (order) by customer. Most customers paid by credit card or check, so you have complete customer data. Walk-in customers who paid cash are given a separate customer number, so you still have the sales data.

Department	**Customers/month**
Clothing—Children	180
Clothing—Men	150
Clothing—Women	180
Electronics	200
Furniture	150
Household	250
Linen	300
Shoes	300
Sports	400
Tools	340

You are trying to determine staffing levels for each department. You know that the store becomes much busier during the end-of-the-year holiday season. For summer months, you have thought about combining staff from the departments. From conversations with experienced workers, you have determined that there is a maximum number of customers that can be handled by one person in a department. These numbers are expressed as monthly averages in the table.

You are thinking about combining workers from some of the departments to save on staffing—especially over the spring and summer months. However, working multiple departments makes the sales staff less efficient. There are two considerations in combining staff members. First, if any of the departments are reduced to a staff of zero, sales in that department will drop by 10 percent for that month. Second, total staffing should be kept at the level defined by the monthly averages. If average staffing (total across all departments) falls below the total suggested, then sales in all departments will fall by 2 percent for each tenth of a percentage point below the suggested average.

10. Using the database and a spreadsheet, determine how many workers we need in each department for each month. Present a plan for combining departments if it can save the company money. Assume that sales members cost an average of $1,000 a month. Two queries have already been created by the MIS department and are stored in the database: SalesbyMonth and SalesCountbyMonth. The first totals the dollar value; the second counts the number of transactions.
11. Write a report to upper management designating the appropriate sales staff levels for each department by month. Include data and graphs to support your position. (*Hint*: Use a spreadsheet that lets you enter various staffing levels in each department in each month, and then calculate any sales declines.)
12. Create a PivotTable for the company that enables managers to evaluate sales by employee by department by month.

Technology Toolbox

13. Create the PivotTable report for Rolling Thunder Bicycles. Briefly summarize any patterns or problems you identify.
14. Using the Rolling Thunder Bicycles query, create a PivotChart and compare sales of the different models over time. Identify any patterns that you see.
15. Research an alternate cube browser (such as SQL Server or Oracle) and explain how it is different from the Excel PivotTable. If you have access to the tool, build a small example.
16. Compute the average number of days it takes to build a bicycle (ShipDate – OrderDate) for each month. Import the data into Excel and forecast the trend. First, forecast it based on all of the data. Second, forecast it for three time periods: (a) the early years, (b) the middle years, and (c) the most recent years. Look at the initial chart to estimate the breaks between these three sets, or just divide it into three equal-size groups if you do not see any good break points. Comment on any differences or problems.
17. Using federal data (start at www.fedstats.gov), compute a regression analysis of Rolling Thunder sales by state by year compared with at least population and income.
18. Choose a company and identify the primary dimensions that you would create in an OLAP cube if you were a manager at that company. Hint: Focus on your major area.

Teamwork

19. Have each person find and describe a problem that could benefit from a GIS. Make sure it needs a GIS, not just a mapping system. Combine the results and compare the types of problems to identify similarities.
20. Build a decision tree to test whether a specific student next year can take this class.

21. Many classes fill up early and the dean keeps a wait list for adding students at the last minute. Build a decision tree to evaluate each student on the list to determine priority for adding that specific person to the class.

22. Each person should identify a problem that could be solved with a rules-based expert system. Combine the results and compare the types of problems to identify similarities.

23. Using Rolling Thunder Bicycles, have each person forecast the sales by one model type for six months. Combine the individual model results and compare this value to the forecast based only on total sales.

24. Select an economic data series such as personal income (check www.fedstats.gov). Place members into one of three subgroups. Have each group forecast the series using a different methodology. Compare the results. If you have sufficient data, leave out the most recent data, and then forecast those values and compare the forecasts to the actual.

25. Choose a publicly-traded company and collect basic quarterly financial data for the company for at least 10 years. It is easiest if you assign specific years to each person. Put the data into a spreadsheet or simple database. Create a PivotTable and Pivot Chart to examine the data. Create a report containing some of the charts and tables and any conclusions you can make.

26. Have each person find a problem that could benefit from a neural network. Describe how the system would be trained. Combine the individual comments and identify any commonalities.

Rolling Thunder Database

27. Identify shipments where receipts do not match the original order. Provide a count and value (and percentages) by supplier/manufacturer.

28. Analyze sales and discounts by employee and by model type. Are some employees providing higher discounts than others? Are we discounting some models too much or not enough?

29. The company wants to create an online ordering system. Create a decision tree to help novices select the appropriate bicycle and components. If necessary, consult with a friend or relative who can be considered a bicycle expert.

30. Use queries to extract sales data by model type and month. Use a spreadsheet to forecast the sales of each quantity of model type by week for the next year. *Hint: Use Format([OrderDate],"yyyy-mm") to get the month.*

31. What pattern-matching types of decisions arise at Rolling Thunder that could benefit from the use of neural networks?

32. What aspects of customer service might be automated with expert systems? What are the potential advantages and disadvantages?

Additional Reading

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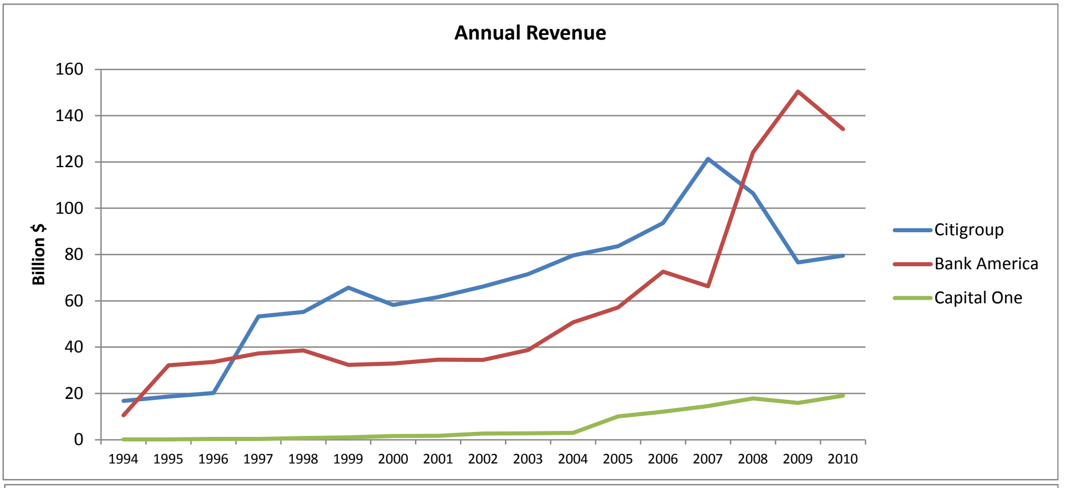
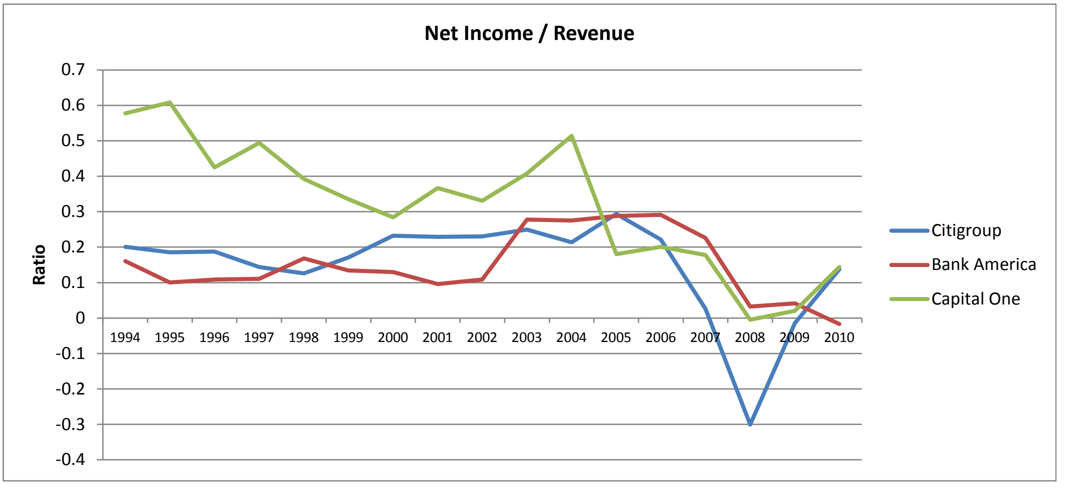
Cases: Financial Services Industry

The Industry





The financial industry is interesting. It is huge and everyone interacts with the trillions of dollars a day handled by the global financial system. It is also complex, with many different types of firms involved, and constantly creating new financial tools. At one point, the financial industry was driven by banks. Today, banks still play important roles, but where do people put their money? In the stock market or other investments. So brokerage firms have a strong role. How do consumers pay for things? With debit cards and credit cards. So the card-processing sector, led by Visa and MasterCard, plays a huge role in the industry. As the national laws have changed, mostly relaxed, over the past few years, the industry has become even more complex. Banks can once again sell stocks and investments, as well as insurance. And brokerage firms and insurance companies can perform banking functions.

Making Money

How do brokerage firms make money? They used to make a profit on transaction commissions, as much as several percentage points per trade—amounting to hundreds or thousands of dollars every time a client bought or sold a stock. With the advent of online trading, pushing the discount brokerage firms, commissions fell to fixed rates of $10 to $20 per trade, a tiny fraction of what they were and under 10 cents a share. The big firms tried to convince customers that their higher fees were worthwhile because they also provided investment advice. But with tainted advice, and a huge amount of data available free to customers online, the full-price firms suffered.

How do banks make money? Banks make money in two ways: interest rate spreads and fees. Interest rate spreads are the difference between the rates the banks charge borrowers and the amount the bank has to pay to obtain the money. Banks select different lending markets (consumer versus business) and have diverse ways of obtaining funds (deposits, loans from other banks or the Federal Reserve). Likewise, fees vary depending on the type of bank. Consumer-oriented banks receive fees from customers (such as checking account fees). Business or investment banks charge fees for more sophisticated services.

How do credit card companies make money? Here the answer is trickier, because several types of companies are involved. The transaction-processing organizations (Visa and MasterCard) receive a fee for every transaction handled through the clearing system. However, banks ultimately issue the cards and are responsible for the money. A consumer bank issues a card to customers and is responsible for paying vendors for legitimate transactions. The consumer bank makes money on consumer fees (usually low today) and interest charges to customers on outstanding balances. It also uses the cards as a marketing tool to attract customers and encourage them to purchase other services. The merchant bank is responsible for ensuring that the merchant is legitimate. It makes money by taking a percentage cut of the merchant's credit card (or debit card) sales. In 2011, the U.S. government joined Europe and imposed caps on merchant fees for debit cards (not credit cards). So banks began cancelling debit card promotional programs and scrambled to find other ways to charge fees.

Brokerage Firms

More than three-fourths of American's liquid assets ($12 trillion) are in stocks, bonds, and money market funds [Revell 2002). How safe are these assets? Do you trust your broker? Do you trust the advice from brokers? In April 2003, forced by a lawsuit led by New York attorney general Eliot Spitzer, 10 of the largest Wall Street investment banks paid fines of $1.4 billion (Nocera 2004). The money was a settlement for providing misleading investment analysis. The brokerage firms usually wrote glowing reports of companies—urging people to buy stock in specific companies. Many of the reports were written because the firms were vying for investment banker contracts with the same companies. In exchange for glowing reports, the companies provided more business (and fees) to the brokerage firms. James Freeman, a former research director, notes that analysts "went from having investment banking deals pushed on them in the 1980s to becoming the greedy pigs at the center of it" (Nocera 2004).

Credit Cards

At one time, the credit card industry was neatly divided into three main segments: the upper end controlled by American Express, the middle tier targeted by Citicorp, and the subprime market pursued by Providian. As a fourth group, MBNA targeted a wide swath of customers with its affiliate cards. Most card companies gained market share by blindly sending 5 billion solicitations a year to U.S. consumers (Gross 2002). Capital One grew by using targeted marketing and thousands of marketing tests with different groups of potential customers. Nonetheless, with competition at a peak for high-end customers, profits were squeezed. Companies were increasingly tempted to go after the subprime market—where they could charge higher interest rates in exchange for greater risk. But as the economy turned down and interest rates increased, this strategy results in greater losses when customers do not pay their bills or even file for bankruptcy (Dugas 2002). Providian lost 90 percent of its stock market value from mid-2001 to mid-2002. Capital One also faced greater losses, but not as large as many other companies. The 2003 settlement with Visa and MasterCard ultimately affected profits for the industry. Wal-Mart had sued the two credit card companies to break up their power to force merchants to accept higher costs for debit cards. The win by the merchants reduces the power of the card companies and banks, and should ultimately reduce fees paid by merchants (www.cardweb.com).

Banks

Citibank (or the parent company Citigroup) is one of the largest banks in the world. In 2003, it earned $17.9 billion in profits, the most ever by a single bank (Economist 2004). In 2010, net income was $10.6 billion (2010 Annual Report). Over the years, it has suffered several problems along with other banks, including from the huge losses on international loans to South America in the 1980s to the investment banking scandals in the 1990s. The company agreed to pay $400 million as part of the $1.4 billion investment banking settlement in 2003, the largest payment by any of the companies involved. Also like other banks, the company grew through acquisitions of other banks (Primerica in 1988), insurance companies (Travelers in 1993), brokerage firms (Shearson and Salomon in 1998), and credit cards (Sears in 2004) (Rosenberg 2003). In fact, the last decade of banking in the United States can be best characterized by the mergers. A handful of banks control a huge number of deposits (Citibank, Bank of America, J.P. Morgan Chase, Wells Fargo, and Wachovia) along with a few large regional banks (Stone 2003). Ultimately, one limiting factor to mergers is that federal law currently prohibits a single U.S. bank from holding more than 10 percent of the consumer deposits. Banks have also been one of the big beneficiaries of the loose federal monetary policy of the early 2000s—making it easy to borrow money at almost no cost.

The entire banking industry was rattled in the 2008 recession and housing market crash. All of the major banks in the U.S. and many banks in other countries were bailed out by governments. A few banks were allowed to fail, and a few others merged with larger banks. The banks most involved in shaky mortgage loans were the hardest hit and the first to go. Brokerage firms were also forced to merge in order to survive. For example, WaMu (savings bank) was eventually sold to JP Morgan Chase, and Merrill-Lynch (brokerage) was picked up by Bank of America. The crisis revamped banking rules and brokerage oversight, but the process is ongoing and will take many more years to stabilize (Sorkin 2009).

Decisions

All aspects of the financial industry heavily utilize information technology. All firms face difficult daily questions on how to balance risks and profits. Overall, banks have profited because they have become more adept at identifying potential bad loans and diversifying risk. The entire industry has become more interconnected through new financial devices to share risk and create new products. The use of credit-default swaps and derivatives has been credited with protecting banks in the downturn of the early 2000s (Economist 2004). Derivatives spread risks across the entire industry and multiple firms, which is good. But, it means that all companies, investors, and regulators have to carefully monitor a wide range of financial indicators and evaluate large-scale effects. How can anyone possibly handle this much data to make informed decisions?

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Case: Citigroup

Charles Prince III, general counsel of Citigroup explained the overall challenges facing management: "You've got five or six or seven businesses—credit cards to mortgages to personal loans to investment banking to commercial insurance. They relate in important ways, but they're different. And they're all over the place. No one has ever had a company as broad in geographic scope [101 countries], as broad in product set, and as deep in size" (Loomis 2001). Sandy Weill gained control of Citigroup (ticker: C), the parent company, in 2000 after a merger between his company (Travelers) and Citibank. In 2001, most of the top-level management was reorganized, but the structure is a little non-traditional. Robert Willumstad is head of consumer business. Michael Carpenter runs the corporate division including the Salomon Smith Barney brokerage and Citi's commercial bank. Thomas Jones runs the investment management and private bank. Bictor Menezes heads the emerging markets section. Charles Prince and Jay Fishman, technically co-chief operating officers, also report directly to Weill. Prince handles operations and administration, Fishman risk and finance. Neither has any direct authority over the other business leaders. One of Fishman's jobs is to synthesize the overall risk picture of the business (into a 54-page monthly book), so that everyone can see the current issues and risks. The lines in many cases are somewhat blurry. Prince, for example, has a responsibility to promote cross selling of products. Because most of the company growth has come from acquisitions, few people down in the hierarchy know much about the other divisions and options. Chief financial officer Todd Thomson also has oversight of cross selling. Yet, neither Prince nor Thomson has direct authority over the businesses that do the cross selling. Weill points out that "this company is too big to micromanage, but it's not so big that you can't know what's going on" (Loomis 2001). Overall, the combination of a huge bank and brokerage firm creates significant advantages over the competitors. When necessary, Citigroup can swing an investment underwriting deal by offering a Citibank loan—something that is much harder to do at brokerage firms like Merrill Lynch.

One controversial step Weill has taken is to minimize the use of the Internet. Instead of trying to run it separately, he moved the projects into the subdivision units and asked them to merge them into their own operations—while trying to reduce costs. Similarly, the Salomon Smith Barney retail brokerage is a full-service company and does not offer low-cost Internet trading. On the other hand, Deryck Maughan, CEO of E-Citi worked hard to establish an electronic foreign-exchange market called Atriax in partnership with three other large banks. "We are saying that we would rather disintermediate ourselves in partnership with others and grab a large share of the new market than sit around in some pre-Information Age factory" (Loomis 2001). In October 2003, Weill remained chairman but made Prince CEO and Willumstad president (Stone 2003).

American financial institutions were hammered by the recession of the early 1990s, even Citibank came close to going under. Yet with the recession of the early 2000s, most banks, including Citigroup, increased profits. Average return on bank assets jumped from 8 percent in the 1990s to 16 percent in the 2000s. One reason is that the 2001 recession was not as deep, and banks are not as tied to corporations as before, supplying 40 percent of the funds today versus 50 percent a decade earlier. Banks also profited from the drop in interest rates engineered by the Fed. But banks are still the biggest source of funds for companies. The big change: a substantial improvement in risk management at American banks. Doug Woodham of Moody's observes "there has been a step change in risk management" (The Economist 2004). For example, mortgages have been turned into securities that are sold on a national market—spreading the risk away from the issuing bank. Credit-default derivatives have accomplished the same task for corporate loans, with the market reaching $350 billion in 2003.

The Hispanic population represents a growing market—particularly for Citibank with its international reach and reputation. In 2004, Citibank created a checkless checking account specifically for Hispanic customers. Many workers from South America come to the United States to make money, which they send back to their families. Yet many of them do not realize the importance of banks and ATMs in the U.S. economy. Most have difficulty opening checking accounts. The Citibank account relies on a debit card and Citibank's international collection of ATMs. Workers can deposit money in the account, and family members can withdraw it almost anywhere in the world through a local ATM (Wentz 2004).

Citibank is one of the largest issuers of credit cards in the United States. Yet that market is stagnant with intense competition and little opportunity for profit.

Some firms have tried to expand profits by going after the subprime market, but Citigroup has resisted. Instead, it is aiming to expand its reach globally. Leveraging its experience in emerging markets, it began offering Visa cards to Chinese consumers in February 2004. The charges can be paid using either dollars or Chinese yuan. Charles Prince and other dignitaries opened the service with parades through the streets of Shanghai. In 2003, only 25 million of the 1.3 billion Chinese citizens held credit cards. Some experts expect the number to easily triple in 10 years. Although the untapped market seems to offer incredible benefits, the risks are enormous. There is only one credit bureau in the entire country, minimal market research, and high bank fraud. Similar expansions of credit in Hong Kong and Korea resulted in huge losses from personal bankruptcies. Citigroup is mitigating the risk by performing their own background checks, only issuing cards to clients older than 21, and requiring an annual income of at least $6,000 (restricting the market to only 10 percent of Shanghai's 16 million residents). Citibank has also devised a mathematical scoring system to asses each individual's credit risk. The McKinsey consulting firms notes that the current default rate in China is 1.5 percent compared with 5 percent in the United States. An interesting twist to the risk problem is that the customers tend to pay off their card in full each month, so the bank has to make its money on fees instead of interest charges. (Baglole 2004).

To train brokers and agents, Citigroup needed a better way to communicate. In 2004 and 2005, the company installed IBM's Digital Media for Banking technology that enables it to stream live and archived content to 300,000 PC desktops across the company's office and branches (Mearian 2004). Communication with external organizations is more complicated. A key feature in the modern banking system is communications from the banks to the credit bureaus. On a regular basis, Citigroup sends a tape of customer data and payment histories to various credit bureaus. On May 2, 2005, Citigroup sent a tape to an Experian facility in Texas via UPS. However, the tape never made it to the company and UPS was unable to track the package. The unencrypted tape contained data on 3.9 million customers including Social Security numbers and payment history. After the incident, Citigroup decided it would be safer to begin encrypting the data on the tapes (McMillan 2005).

In early 2007, Citigroup laid off 17,000 workers in an effort to cut costs by $10 billion. The company also reorganized IT operations, largely by consolidating data centers. The company said that "simplification and standardization of Citi's information technology platform will be critical to increase efficiency and drive lower costs as well as decrease time to market." The company also planned to move 9,500 back-office positions to lower-cost locations, including off shore (Vijayan 2007). Analysts observed that Citi had little choice because between 2000 and 2005 its revenue increased by 8 percent while costs soared by 15 percent. Citigroup planned to close half of its 42 data centers. Much of the savings will come by replacing server clusters with grid computing based on thousands of smaller computers networked together (Crossman 2007). Another part of the plan involved reducing its credit card platforms from 12 down to 2, and reducing mortgage-origination software systems from 5 to 1 (McDougall 2007). However, at the same time, Citigroup announced that it was upgrading 325,000 employee desktop PCs to Windows Vista (Lai 2007).

The housing market collapse of 2007-2008-ongoing caused huge problems for most banks. The main problem was that banks had made loans to weak customers who could not pay them back. When housing prices collapsed (many cut in half), borrowers decided to default on their loans and walk away. Banks who made the loans had resold the loans as packages to everyone else. The entire banking industry was hit with a liquidity crisis. Citigroup alone posted losses of $27.7 billion in 2008 and $1.6 billion in 2009. With a huge infusion of cash by the federal government, Citigroup returned to profitability ($10.6 billion) in 2010. Homeowners did not really gain anything. Banks were also required to increase their capital holdings to reduce the risk of future meltdowns.

To reduce costs, Citigroup cut another 52,000 jobs at the end of 2008. Many of the job cuts came through selling subsidiaries, including the sale of Citigroup's India-based computer management center to Wipro (Thibodeau 2008).

Largely due to the financial crisis, banks largely made few changes in operations or technology. On the other hand, security issues continued. Citigroup was hit by hackers who stole card numbers from over 360,000 accounts (McMillan 2011). Hackers did not get into the main database, but were able to guess account numbers and log into the customer Web site. Sensitive data such as Social Security Numbers, expiration dates, and CVV codes were not compromised. Still, the thieves racked up $2.7 million in charges on 3,400 accounts. The bank covered those losses, and issued new cards to all of the affected customers.

Many banks have jumped on the smartphone platform and offer apps to help customers monitor their accounts and transfer money. Citigroup encountered a problem with their early version. The software stored account information on a filed on the iPhone, and apparently this data was not encrypted. If someone lost a phone, it would have been relatively easy for someone to read the file to get the account information. Citi releaed an upgrade that removed the file (Keizer 2010).

In another interesting security problem, Citigroup reported that a former vice president (Gary Foster) allegedly stole $19.2 million from corporate accounts that were in his responsibility (Bray and Rothfeld 2011). Basically, he is alleged to have set up false contracts and just wired the money to his own account. The transactions were uncovered in an audit. Shannon Bell, a Citi spokeswoman stated that "We are outraged by the actions of this former employee. Citi informed law enforcement immediately upon discovery of the suspicious transactions and we are cooperating fully to ensure Mr. Foster is prosecuted to the full extent of the law."

Questions

1. How does Citigroup use models and information systems to make decisions in the credit card market?
2. How is the Chinese and Southeast Asian market for credit (especially in Korea) different from that in the United States?
3. How could Citigroup make better use of the Internet?
4. How can models, expert systems, and other information tools help Citigroup manage such a large organization?

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Case: Capital One

As a newcomer to the credit card industry, Capital One (ticker: COF) needed an edge. The company created the edge by building the Information Based Strategy (IBS). The system is highly focused on testing and evaluating various options before offering them to the public. The three-step approach: (1) create a new product and find a target population, (2) create a test by changing the variables and seeing how the group members react, and (3) use the test results to further divide the segment, and then test specific campaigns against those segments. By specifically targeting rates, fees, and options to each market, Capital One was able to obtain high response rates, reducing the costs of acquiring a customer. The company conducted 45,000 tests in 2000 alone (120 per day). The company extended the process to its Web site, tracking visitor activity, tailoring options to each specific customer, and using the background data to buy ads on other sites with the appropriate demographics. For example, if sports enthusiasts responded well to certain features, those features would be advertised on sporting sites. With this process, the company opened 2 million new accounts online (Cohen 2001).

The company uses the test results and marketing to tailor interest rates and fees to individual customers. In effect, it has created 100,000 different segments or product combinations. The process extends to the customer call center. Capital One uses Cisco Systems Global Service Logistics (GSL) system to route calls. The system retrieves information about the customer and routes the call to the most appropriate representative. For example, a customer who routinely pays off the monthly charges might be routed to a representative to sell a platinum card with a higher balance.

In a different twist, Capital One uses a similar process to hire and promote employees. It records specific data on every hire, including scores on a timed math test and a behavioral test. During promotions, the characteristics of successful employees are listed for each job. These characteristics, and the initial test scores, are used to refine the hiring process for each type of job. The process fits employees to jobs and reduces hiring costs (Cohen 2001).

For several years, Capital One had enviable growth rates with revenue growing from $95 million in 1995 to $4.97 billion in 2001, from 6 million customers to 33 million (Cohen 2001). Yet because of the extremely competitive nature of the industry, Capital One had to extend into the subprime market to capture more customers. With the economic downturn, the subprime market crashed in 2002. Capital One suffered along with the others in the industry. For the first time, managers also revealed how dependent Capital One was on the subprime market. In 2002, 40 percent of its cards were in the hands of subprime customers (Albergotti 2003), far above what most investors had believed. The market punished Capital One's stock. Yet, ultimately, Capital One's system worked. The company's risk management techniques gave it one of the lowest levels of bad loans—until 2003. The company wrote off bad debt, but earnings eventually rose and the company survived. The company has reduced its exposure in the subprime market. Federal oversight also forced companies to reevaluate the subprime market—regulators have been attempting to limit fees and penalty charges (Smith 2002). But, the strategic shift leaves Capital One facing more competition in the higher quality markets. Its profit margins have shrunk accordingly—down to 16 percent in 2004, half their earlier levels (Byrnes 2004).

Searching for new markets, Capital One is widening its search into more traditional banking areas. Richard D. Fairbank, the CEO, knows that growth in the card market will be slow. "A lot of the different financial markets are evolving, but the most evolved is the credit card business. This is pretty close to the endgame. We've really got to work for a living these days in the credit card market." His new target: auto loans, installment loans, and even international loans. In particular, he wants to target small businesses. Capital One's lending to small businesses has grown from $400 million in 1999 to $3.3 billion in 2003. At the end of 2003, the company managed $46.3 billion in credit card loans, $8.5 billion in autos, $5.4 billion in installment loans, and $7.6 billion in international loans (Kuykendall 2004).

In the meantime, the company is cutting expenses, eliminating as many as 2,500 of its 9,000 positions in its Richmond, Virginia, headquarters. Fairbanks told employees he needed to cut expenses by 20 percent. "Our businesses need to improve their cost positions to compete in the future against leading players in the financial-services industry" (Hazard 2004). Capital One is also interested in using the Internet to reduce costs. Processing payments online instead of paper checks reduces costs by $1 a year per customer. Persuading customers to accept electronic statements instead of mail cuts costs an additional $5 per customer per year. Rick Long, director of U.S. card operations at Capital One, notes that "our ROI [return on investment] models are built on lowering costs" [Wade 2004). He was emphasizing that Capital One is primarily interested in using the Internet only where it is cost effective. The company is also concerned that customers have to be enticed to use the Internet instead of coerced. "If we drive them to the site, they may not stay" [Wade 2004). Most customers who are interested in using the Internet, enroll within the first six months.

To broaden its reach and financial offerings, Capital One embarked on a campaign of buying retail banks. The company purchased North Fork Bancoprt as well as Hibernia Corp. (Wei 2007) Capital One IT managers were so impressed with Hibernia's deposit-transaction system that they migrated their banking system onto its mainframe package. In its other 9 recent acquisitions, Capital One migrated most operations onto its existing platforms. In particular, HRM, finance, and other operations are transferred to Capital One's PeopleSoft ERP system (McGee 2006).

Like other institutions, Capital One is trying to reduce expenses. In 2007, the company announced job cuts of 2,000 employees in an effort to reduce costs by $700 million (Wei 2007). The IT department is working to cut expenses by reducing the number of servers it runs. Using server virtualization, a hardware-based server can be split into multiple virtual servers, with each one running different operating systems and different applications. One goal is to reduce costs by moving from 1,600 down to 1,100 servers. Le Congdon, VP of corporate technology also said that the technology "buys us time in circumstances where a specific application is ready to move over and we need to shut down that physical location, or where we need to move of aging hardware or software. It also gives us better management tools and controls across the environment. If we can go from 50 percent to 85 percent utilization on the servers, that's free money" (Thibodeau 2006).

Capital One was also hurt by the financial crash. But, because the firm focused on higher-end customers (compared to Providian), it was able to survive the liquidity crash. Rob Alexander, CIO, pointed out that the company was still investing in technology to handle customer transactions. He also emphasized the importance of business analytics at Capital One to ensure the company was making the best decisions possible (Fonseca 2008). Alexander also noted that the IT department maintains an advanced technology group to look at cutting-edge technologies and test them to see how they might improve operations or deliver new business opportunities in the near future.

In 2011, Capital One purchased the U.S. online-banking business of ING—a Dutch bank that pioneered some online banking. The deal will make Capital One the fifth largest U.S. bank measured by the amount of deposits (Grocer 2011).

Questions

1. How does Capital One use decision support systems to reduce risk and increase sales?
2. With its advanced systems, how did Capital One lose so much money in 2003?
3. How can Capital One use technology to reduce its costs?

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Case: Providian/Washington Mutual

The credit card industry has changed in the decades since the 1960s when Bank of America flooded households with millions of cards. Today, trillions of dollars of transactions are paid with credit cards, with 1.2 billion in use in the United States alone. The average cardholder has 2.7 bank cards, 3.8 retail cards, and 1.1 debit cards for a total of 7.6 cards per person. Despite the huge variety, the top 10 issuers handled about 78 percent of the total value at the end of 2002. About 24 percent of all consumer retail transactions are paid with credit and debit cards (www.cardweb.com).

A huge percentage of the U.S. population already holds several credit cards, and banks are constantly competing to give more cards to high-income customers. To most observers, the market appears to be saturated. Customers will switch banks if one offers a better rate or different benefits. Providian Financial (PVN), a San Francisco-based company, looked at this market and decided to find a new niche: the subprime market. According to cardweb, approximately 25 percent of the population has weak credit ratings. The objective was to find low-income people with poor or no credit, offer them a credit card, and then charge huge fees and high interest rates. Shailesh Mehta, who eventually became CEO, developed a complex mathematical model that allowed the company to identify the subprime customers who would be most likely to use the cards, but not default on the loans. One executive characterizes the process as "we found the best of the bad." Since other banks refused to serve this market segment, Providian had solid growth rates and, despite the 24 percent and higher interest rates, was able to claim that it was providing a useful service to the customers. Eventually, other banks (notably Capital One and Household International) jumped into the market. By 2000, 20 percent of the cardholders were classified as subprime (cardweb), and Providian was the fifth largest card issuer in the nation (Koudsi 2002). In 2000, the company was ordered to pay $300 million in restitution for misleading, unfair, and deceptive business practices. To keep growing, the company had to find a new market. It failed in an experiment to go after the platinum market. So, it went after increasingly risky customers. By 2001, when the economy faltered, the subprime market felt the impact first, and the company saw its default rates jump—to a huge 12.7 percent. Amid claims of misleading accounting, the stock price plummeted 90 percent. Cardweb notes that 1.3 million cardholders declared bankruptcy in 2001—which generally erases unsecured credit card debt. Other banks focusing on the subprime market faced similar problems. Bernhard Nann of Fair Isaac, which evaluates consumer creditworthiness, notes that "data used in traditional behavioral models is not quite as powerful as we would like. We'd like to go and expand the universe of data that can be looked at to produce better predictions. That's particularly important in the subprime area." In particular, the company wants to include utility and rent payments in its calculations (Punch 2003).

With the economy improving in 2003 and 2004, Providian was able to sell off some of its loans and write off the really bad ones. The company also refocused its efforts to go after the middle market, people with a FICO score between 600 and 720 (Albergotti, 2003). Although weak, the company was able to report a profit in late 2003 (Business Week 2003). By 2004, some experts saw an improvement in the credit card industry profits. Many homeowners had already refinanced their mortgages—and paid down credit card debt. But, that leaves them free to increase the borrowing—hence increasing profits (Stovall 2004).

Yet, with increasing competition for the platinum and midmarket segments, banks continue to search for ways to make money on credit cards. With low balances and low interest rates, and few new customers, banks turned to fees. Income from late fees and penalties was predicted to reach $13 billion for 2004, with total fees likely to account for 39 percent of revenue (Simon 2004). Providian joined in the parade and increased its fees annually. However, the company also created a "Real Rewards" program, where cardholders accumulate points for cash rebates that can also be used to offset late fees.

In 2004, Providian settled the accounting and insider-trading lawsuits for $65 million (Kuykendall 2004).

In 2005, Providian was purchased by Washington Mutual Bank WaMu (Hallinan 2005). WaMu was formed in 1889 in Washington State. It runs consumer and small-business retail banks from the West Coast to the Midwest. It also has an aggressive home-lending program. In the past few years, it has become known as a bank for taking risks and targeting subprime loans—both in credit cards and mortgage loans. WaMu was pressured by the crashing housing market in 2006 and 2007. Because of its aggressive subprime loans, the company was one of the first to offer new loans to customers to try and move them into safer loans as rates increased, in an effort to keep large number of customers from defaulting on housing loans (Carrns 2007 and Hagerty and Carrns 2007).

WaMu aggressively uses technology to reduce labor costs in its banks. In most of its branches, tellers assist customers with transactions that are handled electronically. Effectively, tellers work at advanced ATM stations that enable them to handle tasks only slightly more complex than a standard ATM machine. If a customer processes a transaction involving cash, the money is dispensed by the machine.

The real estate crash and financial liquidity crunch were tough on WaMu. Essentially, the government forced the sale of WaMu to JP Morgan Chase, who picked up the assets for relatively low cost. Shareholders of WaMu stock pretty much lost all of their value. For a couple of years after the crash, top-level managers tried to argue that the government should not have forced the sale of WaMu, and that government actions might have contributed to the failure of the company. But, in the end, most observers simply blamed the over-aggressive lending practices of the company. When the real estate market crashed, an increasing number of loans turned bad, and even moderately risky customers walked away from their debt. These were the customers targeted by WaMu, and it lacked the capital and stable profits to balance these risks. JP Morgan had to write off at least $31 billion in bad loans (Sidel, Enrich, and Fitzpatrick 2008).

Questions

1. Why is the subprime market so risky and how does Providian use information technology to minimize the risks?
2. How are the platinum and midmarket accounts different from the subprime market, and can Providian use the same models?
3. How can Providian use information technology to increase its revenue from fees?

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Case: Merrill Lynch

For decades, Merrill Lynch (ticker: MER) was the premier brokerage firm. It led the industry in sales and innovations. The firm helped create hundreds of modern companies with its access to capital and the ability to sell stocks. In the 1970s and 1980s, its innovations in money market funds rocked the financial world and resulted in substantial changes to the federal banking laws. It accomplished many of these innovations through technology—and the recognition that money is really data. It expanded its reach overseas, and became the largest retail brokerage and the largest underwriter of stocks and bonds in the world. Through the stock market bubble of the 1990s, Merrill prospered—at least in terms of market share. They helped finance several start-ups and retail stock brokerage revenues grew by $3 billion from 1996 to 1998. But the growth carried equally huge costs: only $100 million of that money made it to the bottom line. By 1998, Merrill's profit margins were 10 percentage points lower than its competitors. At the same time, the growth of online account management and discount brokerage firms had chipped away at the retail end of Merrill's operations. By 2001, even the directors knew that Merrill was in trouble and might not survive. Being the largest was not very useful if the company was not making money (Rynecki 2004). In 2001, the board made the surprising move of appointing Stan O'Neal, the CFO to become the new CEO of Merrill. Recognizing the importance of profits, and seeing limits on the ability to increase revenue, he began focusing on cutting costs. Ultimately, he eliminated 24,000 jobs, including 20 percent of investment banking and analyst positions. He closed 300 field offices and completely pulled out of Australia, Canada, New Zealand, and South Africa. He reduced the number of stocks traded directly by the firm by 75 percent. He replaced almost all of the management from the top down—largely replacing them with younger staffers looking to make their marks. He reportedly often states that "ruthless isn't always that bad" (Rynecki 2004). The result: in 2003, the firm earned a record $4 billion in profit, and pretax margins reached 28 percent—vastly exceeding the high-growth years of the 1990s.

Despite the profitability, the firm still has to worry about revenue. In 2004, with the slow economy and shaky financial markets, Merrill ranked last in sales growth among the Newsday Top 100—with a three-year sales decline of 14.8 percent (Murray 2004). Merrill Lynch is refocusing its retail brokerage operations—on wealthy customers. The company pays higher interest rates to customers with balances over $10 million (McGeehan 2004). Merrill also jumped into the credit card market in 2004. The company realized that customers withdrew $3 billion from their accounts in 2003 to pay off credit card debt. Co-branded with MBNA, the card is designed to provide one-stop shopping for its customers. Merrill is targeting its wealthier customers—in an effort to provide more services, but also to keep control over a larger percentage of their money. The company is offering a variety of awards to entice customers to use them for large transactions (Lieber 2004).

Despite the renewed emphasis on cost, Merrill still has to handle business, and that requires technology. In 2003, the company began the first steps of a $1 billion upgrade to their broker workstation systems. The new Client 360 system is designed to be a total wealth-management tool—largely focused on customer relationship management. It is designed to provide a complete view of customer data to the broker. John Killeen, the chief technology officer, notes that “the tool suite around wealth management is pretty well established across the industry, still what will make this unique is that we are facilitating the relationships for our financial advisers with their clients. … It’s a single-screen representation of the most important and most prevalent questions that a client may ask a financial adviser when they have them on the phone. It will talk to balances; it will talk to progress towards plans, and any important notices that affect that client. And within one or two clicks, we can drill down to greater and greater detail. It represents a huge productivity gain for our financial advisers” (Pallay 2004). Most of the front-end system being developed is installed by Thomson Financial, which is overseeing the integration of work from 400 vendors. The back-end system remains Merrill’s proprietary system, largely running on Microsoft software. The company built a framework that separates the back-end and middle tier systems from the front end. This approach enables the company to alter various components on either end without having to rebuild the entire system. Despite the complexity of the project, Killeen’s focus has been on the end-use applications: “I think the lynchpin around the tools will be client data—who has the greater understanding of the total client relationship, what is important to the client at the different phases of their financial life cycle, and how do we put all of that together so that our advisers are best positioned to work with their client?”

Technology has been driving several changes in market trading for several years. For a while, the stock exchanges frowned on automated trading schemes, but by 2007, they had adopted them wholeheartedly. Brokers, including Merrill Lynch, have developed complex models of trading strategies. Some look for arbitrage opportunities across markets, others look for timing gaps. These systems can generate hundreds of trade orders per second, and generally hold positions for only a few seconds or minutes (Martin 2007). Economically, these systems serve to remove bumps and reduce imperfections in the market. In the process, the large brokers make profits not available to the average investors, but the profits pay for the technology.

In terms of customer-based technology, Merrill Lynch is reportedly the largest customer of Salesforce.com with licenses for 25,000 users (Weier 2007). Salesforce provides customer relationship management software via an online system. The company offers its Wealth Management Edition for Merrill Lynch and other financial institutions. In terms of processing transactions, federal regulations began changing the rules in July 2007 with the implementation of Reg NMS. The regulation requires brokers to automatically and instantly route orders to the market that displays the best price (Horowitz 2007). Only the largest brokerage firms have been able to afford the technology to maintain constant connections and price searches with multiple markets. With many of the exchanges automated, the brokerage computers need to be fast and secure to handle the number of searches required for each transaction. Tim Cox, VP of market structure strategy at Merrill Lynch observed that "The big are going to get bigger. Reg NMS over the course of a couple of months will make technology a real differentiator" (Horowitz 2007).

Merrill Lynch only barely survived the financial crisis of 2008. The company had made huge bets on the housing market—and held those bets on its balance sheet. Its competitor Lehman Brothers was "allowed" to fail by federal regulators—partly to send a message to the rest of the industry. Merrill Lynch would probably have been close behind, but Bank of America took a $50 billion gamble and bought out the company (Farrell 2010). Ultimately, the question of whether Merrill Lynch was worth billions of dollars to Bank of America remains to be seen. Can the division generate enough revenue to justify its continued existence? After all, it is still a high-priced brokerage firm. Perhaps it can help Bank of America in high-end deals for IPOs and other investment banking tasks.

Questions

1. How can Merrill Lynch survive as a full-service broker, particularly with the regulatory changes in investment research?
2. How can Merrill Lynch use information technology to attract and keep the high-end investors that it wants?
3. How can the company use technology to reduce its costs and improve its profit margins?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 10

Strategic Analysis

Chapter Outline

What You Will Learn in This Chapter

- How can you use information technology to improve your organization and make it better than your competitors?
- How competitive is your world?
- What are the main factors affecting a firm's competitive advantage? Where do you begin looking for an edge?
- How can you use IT to gain a competitive advantage? Where do you begin your search?
- How can IT support the operations of the firm to provide a competitive advantage?
- Why is it so difficult to convince management to make strategic changes? What are the risks of strategic decisions?
- Why did so many dot-com firms fail? Do their failures mean there is no viable Internet strategy?
- How do you convince an organization to change strategies?
- Can cloud computing provide strategic advantages?

Delta Air Lines

How can you use information technology to make your company better than your rivals? Delta is one of the original airlines in the United States. Only a handful of the original remain, and most of them, including Delta, are flirting with bankruptcy. Many of the airline executives blame September 11, 2001, the SARS scare of 2002-2003, and the oil price increases of 2003-2004 for their problems. But if you look at revenue and profits over time, it is clear that the big airlines were getting their butts kicked long before these events. In 2005, Delta, Northwest, and Continental were in bankruptcy court—largely to drop their pension plans and renegotiate labor and other contracts. At one point, 50 percent of the U.S. air transportation capacity was operating in bankruptcy. The discount airlines, led by Southwest and joined by Jet-Blue and ATA, have been profitable over the last few years—because they found a way to attract customers and hold down costs.

Discounters and upstarts are not new to the airline industry. In a classic case, American Airlines was able to drive away People Express in the early 1980s with its Sabre reservation system. American pioneered yield management—charging everyone on the plane different prices—trying to get as much money from each person as possible, meaning that businesses paid through the nose while tourists who book in advance get cheap seats. The advantage generated from this system was refined with frequent flier miles and kept American, Delta, and the others on top for 15 years. But Southwest, with a radically different strategy, has slowly grown to challenge the entire industry. Is there another rabbit in the hat for the big, traditional airlines? Can Delta find a new way to use information technology to save the day?

Introduction

How can you use information technology to improve your organization and make it better than your competitors? Can technology make your company the best in the industry? These questions are still being debated, but it is clear that in some cases information technology has provided the ability for companies to dramatically change industries. Figure 10.1 shows that technology can be used to build ties to customers and suppliers—effectively making it harder for competitors to enter your market. A key theory from economics (extensively applied in marketing) states that a firm can make additional profits only by blocking new firms from entering the market. And one of the few legal ways to block firms is to differentiate your product so that customers will perceive it as a separate item. Technology can provide differentiating factors including better service, lower prices, stronger customer relationships, and new features for products.

The reengineering provided by information technology creates additional benefits. It enables you to alter the way an organization operates. However, it is critical that you remember that technology by itself is not a magic wand. Now, for the important question: How can you use information technology to find new opportunities and gain a competitive advantage?

Strategy requires looking beyond the internal factors such as costs and implementation details. Managers need to look at the potential effects on customers,

Figure 10.1

Strategies. Managers are increasingly being asked to find ways to give their firm an advantage over the competition. Information systems can help identify areas that can provide a competitive edge. Information systems can also directly provide services and advantages that are not offered by your rivals.

suppliers, competitors, and other external agents. In some cases, the technology can be relatively common—but the trick is to look for additional benefits. For instance, using social networks for marketing uses relatively standard technology, but it requires a marketing staff that understands the products and the customers—supported by custom search engines and data analytics to determine the most important contacts and strongest effects. Using the technology changes the way the company operates. In this example, instead of relying on traditional sales through distributors and retail stores, companies can choose to interact directly with high-profile customers who then affect decisions by other consumers. The real difference with strategy lies in its goal: to change the way the business operates, and gain an advantage over the other firms in the industry.

Information systems can provide a competitive advantage through decreasing costs, improving quality, establishing ties to consumers or suppliers, differentiating products or creating entirely new products. Computer systems can also create barriers to entry through the need for greater technical skills or increased costs.

Designing strategic systems can be a dangerous task with many opportunities to fail. One complication is that development costs are high. Some strategic systems use new technology, which carries higher costs and a greater risk of incompatibilities and other problems. It is also important to remember that attempts to monopolize a market are illegal, and strategic systems can sometimes come close to breaking the antitrust laws.

The most difficult aspect of strategic systems is coming up with ideas that might give you an advantage. Consequently, a related problem is convincing top managers that a potentially radically new, costly idea could actually work. One way to get ideas is to see what firms in other industries have done. You never know when some of the techniques and tricks used by other companies might be useful to you.

Trends

Ideas and concepts for managing businesses are constantly changing. Many current practices are often traced to Alfred Sloan, who drove the consolidation and expansion of General Motors from 1920 to 1956. Management techniques evolve over time and ideas come from many sources. Through the 1950s, many companies focused on making production more efficient. In the 1950s and 1960s, U.S. firms expanded into wider markets, both nationally and internationally. In the 1970s, managers were preoccupied with the economic changes brought on by oil price rises and consequent shocks of high inflation and high interest rates. The 1970s and 1980s also saw the emergence of increased international competition—for example, between 1960 and 1985, U.S. imports as a percentage of GDP increased from 5.6 percent to 11.5 percent. The 1990s and 2000s saw increasing international competition as well as consolidation among large firms. Many industries now support only a handful of large firms.

Through the 1960s and 1970s, the use of MIS was largely governed by its capabilities and the immediate needs of the organizations. The most common MIS objective was to save money and time by automating transaction-processing tasks. The projects were evaluated on the basis of how much money they could save. Eventually, managers came to realize that computer systems have other advantages. A new technology might enable the firm to provide better service to customers. The company that is the first implementer of a technology might find it easier to attract customers, giving it a competitive advantage over the other firms. For example, the first banks that installed ATMs to provide 24-hour access gained an advantage over their competitors.

Now, everyone uses information technology for transaction processing and some decision-making. Still, new opportunities arise to be a leader, such as connecting to customers through the Web, social networking, and mobile devices. The key is to always look for ways to use new technologies and identify the benefits as well as the costs to find the optimal timing.

The Competitive Environment

How competitive is your world? One of the important trends facing most businesses today is the increased level of competition. As indicated in Figure 10.2, improved telecommunications and faster delivery services mean that local firms face competition from regional, national, and international firms. Local firms have to compete against national mail-order companies, which offer wide selections, next-day delivery, and low prices. The Internet, home shopping channels, and toll-free phone numbers make it easier for consumers to compare prices, putting pressure on all firms.

Large national retailers and franchises put pressure on local stores. They also compete against themselves for market territories. Their size gives them leverage in dealing with manufacturers. By purchasing in large quantities, they can negotiate lower prices. Their high volume also makes it easier for them to buy from foreign producers.

Reality Bytes: Business Trends

Business statistics indicate a clear trend toward the increased importance of service-oriented firms. Service firms are well suited to certain strategic uses of information systems. In particular, product differentiation, product quality, and new products are typically useful strategies. In many service industries, information is the primary product, so technology is especially valuable.

The financial industry provides several strategic examples, such as the Merrill Lynch Cash Management Account, ATMs, or new financial instruments created by brokers. Similarly, Federal Express uses tracking information to differentiate its service from its rivals' offerings. Likewise, the airlines used their reservation systems to give them a competitive advantage in transportation services.

Several international trends are creating increased competition. The international search for lower manufacturing costs puts pressure on firms to cut their costs. For instance, the Japanese have moved production to other Asian nations to build television sets and automobiles. The demographics of an aging population have led Japan from a labor surplus to a labor shortage, and Japan has moved much production to lower-cost nations. Decreasing trade barriers throughout the world also creates larger markets. As eastern European economies rebuild, as the European Union takes shape, and as Chinese, Indian, and Mexican incomes increase, consumers will be able to buy more products. Although the prospect of these increased sales is enticing to U.S. manufacturers, many complications exist. If a competitor becomes established first, it will be a stronger and tougher com-

Figure 10.2

Competition. Even industries with one or two front-runners often have a pack of hungry competitors trying to chase them down. Today's businesses face competitors from around the world.

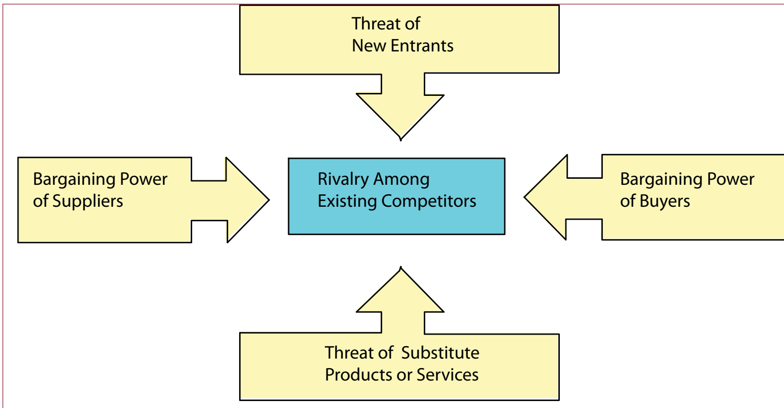


Figure 10.3

Porter's Five Forces model. Strategies often involve external agents: customers, suppliers, competitors, the threat of new entrants, and substitute products.

petitor in the United States. New firms will arise or expand in these international markets, giving them a stronger base to increase sales in the United States, providing for increased competition.

The business world has definitely become more price-competitive in the last decade. Large firms competing on price continually squeeze suppliers to cut costs and offer discounts. Think about the effect of Wal-Mart. How does Wal-Mart continue to decrease costs? Yes, through internal savings, but also through leaning on suppliers. On the other side, the Internet and mobile computing have made it easy for consumers to find price information and compare products instantly. It is easy for consumers to use their cell phones to take a photo of a bar code and receive instant price comparisons, quality ratings, and customer comments. Certainly retailers need to consider the effects of these technologies, but manufacturers must also evaluate the competition in terms of price and quality.

External Agents

What are the main factors affecting a firm's competitive advantage? Where do you begin looking for an edge? Competitive advantage can be gained by establishing or changing relationships between the firm and its **external agents**. External agents consist of suppliers, customers, rivals, potential new entrants, substitute products, and sometimes the government. Figure 10.3 portrays these relationships in Porter's **Five Forces model**. From a systems perspective, each of these entities is outside the control of the firm. Yet they strongly affect the company. Through improved ties to these agents, they become part of your system, which can be used to improve the competitive position of the firm.

Buyers

Who are your customers? This famous question is used to highlight the issues in an industry. The answer might seem obvious, but many firms have layers of customers. To a retail outlet, customers are likely to be individual people. As shown in Figure 10.4, a large manufacturer might have several levels of customers, ranging from wholesale firms that buy in bulk, then sell to distributors, which deliv-

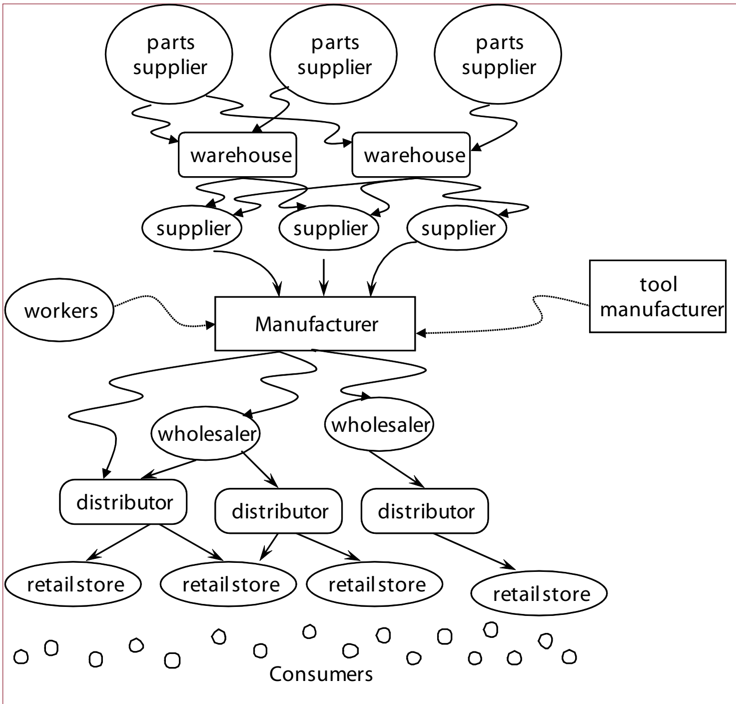


Figure 10.4

Production chain. Modern companies have ties to hundreds or thousands of entities. Sometimes a company will own several pieces of the production chain (vertical integration). Sometimes the company might expand horizontally by building related businesses. Each linkage requires communication and offers the possibility for strategic gain.

er products to retailers, where the final customer purchases the product. Having more intermediate levels between the manufacturer and the customer can make it much harder to manage the firm. It also makes it more difficult to identify the needs of your customers—particularly when information from the various levels conflicts. For instance, an end consumer might want more features, while a retail store might want simpler products and fewer models to reduce stocking problems.

A common strategic goal is to get closer to the customers. Information systems can be used to strengthen the ties among the customers, manufacturers, and various intermediaries. For example, you could build electronic ordering systems, with terminals in the retail stores to capture current sales levels. The systems could also be used to send new product information to the customers, or collect feedback on various attributes, or provide immediate answers to question from retailers and customers.

The issue of buyer's power is critical in Porter's model. For example, if you are a small company selling parts to General Motors, then you have little power in that relationship. So, you will need to look at the supplier side for strategic options.

Suppliers

Suppliers can provide individual parts, entire products, or even services (such as a bank that lends money). Three major issues involving suppliers are price, quality, and delivery schedules. Just as with customers, problems can arise when many layers of suppliers exist. For instance, increased layers can result in longer delays between ordering and delivery because the supplier has to contact its supplier, who contacts its supplier.

Quality management is also more difficult when there are several layers of suppliers. A fundamental element of **total quality management (TQM)** states that quality must be built into every process and item. Picture the problems that arise if quality is measured only in terms of the output at the manufacturer. When a defective product is found, there is no information about the cause. How can the problem be corrected? Managers need to know where each component came from and evaluate the quality as soon as possible. For instance, if there is a defective product, you could check each component to determine its original manufacturer. The manufacturer could be notified of problems, and you could search other items for similar defects. The manufacturer could use this data to identify problems with individual production lines.

Information systems can be used to build electronic ties to suppliers. Common uses of these systems include placing orders, tracking shipments, monitoring quality control, notifying partners of changes in plans, and making payments. Electronic links provide faster responses, better record keeping, and fewer errors. They also offer the potential strategic benefits described in the next section.

Rivals, New Entrants, and Substitutes

The goal of a strategic approach is to derive a competitive advantage over the **rivals**, or other firms in the industry. There could be many competitors or just a few larger rivals. The competition could take place in a small town, across a nation, or worldwide. One of the first steps in any strategic analysis is to identify the primary competitors and to assess their strengths and weaknesses. Is the industry rivalry intense with constant price movements and attempts to gain market share? Or do companies rarely adjust prices and are largely content to service existing customers?

One issue to remember about competition is that it never stops. Coming up with one strategic idea is not good enough. For example, American Airlines and United Airlines spent millions of dollars to build reservation systems as strategic systems. Today, all major airlines have access to these systems, and each airline must continually work to improve its system to provide new enticements to customers. Similarly, automobile companies designed computerized diagnostic systems to improve services offered by repair shops. Today, all of the manufacturers have essentially the same systems. In some cases, rivals might offer improvements over your ideas, which will put the originator at a disadvantage. However, the firm that first implements a new strategy can gain recognition and market share. It is important to remember that companies must continually improve and seek new opportunities.

A related issue is the concept of potential competitors or entrants in the business. In some cases, you might identify the major rivals, implement a strategy, and then immediately lose everything as new firms enter your business. Entrants might build their firms from scratch, such as the way Burger King built new stores in the same areas as McDonald's restaurants. Alternatively, other firms

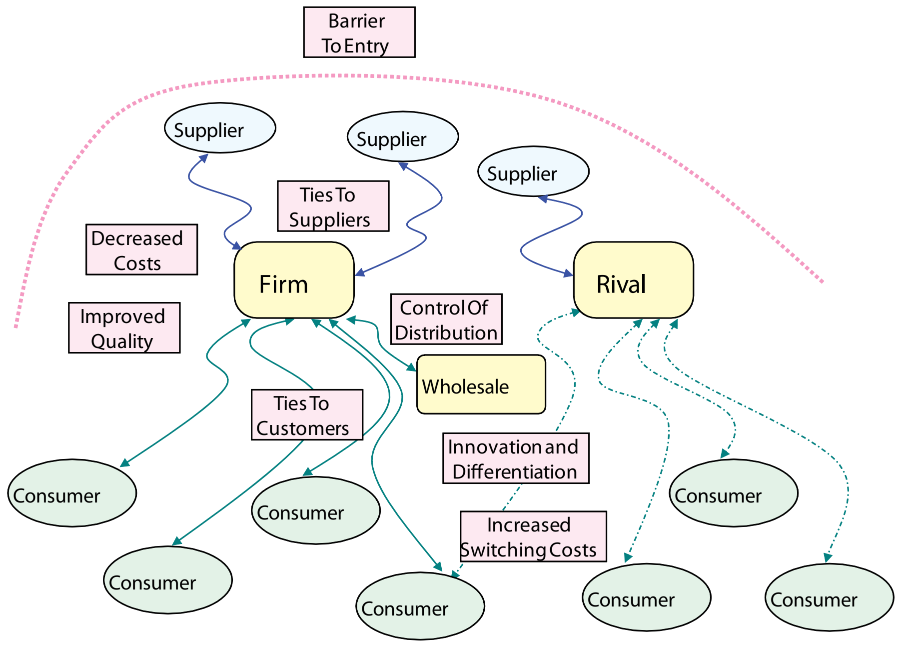


Figure 10.5

Methods to gain competitive advantage. Examining the production chain highlights several useful techniques. Barriers to entry keep out potential competitors and substitutes. Ties to suppliers can cut costs, improve quality, and lock out competitors. Control over distribution provides stronger markets and keeps out competitors. Building ties to customers builds loyalty, improves products and increases margins. Creating switching costs keeps customers loyal.

may increase the sales of products that are similar to your products. Substitute products are related economically by the degree to which consumers are willing to use one product instead of the other. A classic example comes from the late 1970s, when the U.S. economy faced high inflation rates and banks were subject to limits on the interest rates they could pay on deposits. Merrill Lynch, the stock brokerage firm, introduced a service enabling customers to store their money in a wide variety of financial instruments that paid significantly higher interest rates than did checking accounts, and still write checks on the account. Many larger customers took their money away from banks and put it in these asset accounts. These new accounts were perceived as close substitutes for traditional bank services, and people transferred huge sums of money out of the banking system.

The key point is that you need to take a broad look at your firm and the industry. Know who your competitors are and how they operate. Are other products or services offered by other industries that might attract your customers? If you make a change in the way you do business, find out how it will affect your rivals. Determine how changes will alter the industry. Will they provide an opening for firms in other industries?

Government Regulations

In any economy, government intervention has a strong influence on the firm. There are myriad government agencies, regulations, taxes, and reports. The situation multiplies for multinational firms that are subject to the regulations of many nations. These agencies and regulations can have strong effects on the profitability of a firm. Generally, an individual firm has no control over government regulations, but sometimes suggestions can lead to modifications. For instance, it is now possible to submit some documents to government agencies in computer form. In fact, some reports (such as 10K or 10Q financial reports) are required to be filed electronically. Electronic forms can decrease your storage costs and make it easier to find documents that have been stored for long periods of time.

IS Techniques to Gain Competitive Advantage

How can you use IT to gain a competitive advantage? Where do you begin your search? These questions are difficult to answer. Keep in mind that your competitors are asking the same questions every day. Competitive advantage may be achieved with many techniques in business. Information technology is one area that may provide several opportunities. In general, MIS techniques may not be better than other methods. However, some firms have experienced considerable success from using these techniques, so they are well worth considering. Moreover, the rapid changes in technology often lead to competitive advantages if your firm is the first to find a creative use for the new technology. The other side of the coin is that untested new technologies may not work as planned. Hence, the pioneer is taking a risk: If the project fails, the development costs may put the firm at a competitive disadvantage.

The fundamental mechanisms for gaining competitive advantage are barriers to entry, switching costs, lower production costs, product differentiation, control over distribution channels, innovation, and quality control. These techniques are illustrated in Figure 10.5. The question we wish to examine is how information systems can take advantage of these techniques.

Barriers to Entry

A fundamental concept of economics is that to make extra profits, you need some mechanism to prevent other firms from entering the industry. Otherwise, as soon

Figure 10.6

Several methods can build barriers to entry. Be careful. Many attempts to erect barriers are considered illegal under antitrust legislation.

Sources of Barriers to Entry

Economies of scale (size).
Economies of scope (breadth).
Product differentiation.
Capital requirements.
Cost disadvantages (independent of size).
Distribution channel access.
Government policy.

Reality Bytes: People Express Airlines (Classic Case)

In 1981, Donald Burr's People Express Airlines was the darling of the airline industry and American management. In four years the fledgling airline grew to a $2 billion company. People Express was cited in In Search of Excellence as an ideal American business because of its flat organizational structure and compensation plan that based reward on stock growth. All employees, whether customer representatives or pilots, were viewed as equally valuable to the company. Growth seemed to be unlimited and the airline could not process applications or reservations fast enough. Yet on January 18, 1985, People Express Airlines declared bankruptcy. Soon thereafter, the parts of the empire that Burr constructed were auctioned off and the routes redistributed.

The basic philosophy driving People Express was to make air travel available to everyone. At its peak, People's low fares brought thousands of students, the elderly, and the middle class through Newark, New Jersey. The waits were horrendous and the service was chaotic. Yet the $29 fare made the hassle worth it, particularly when the other airlines were charging five times as much. People's fares allowed the carrier to book and fly full planes.

As long as the flights were full, the profits were easy to calculate: determine the price of the fuel and the equipment and employee cost per flight of the plane; determine a per flight fare that would provide a profit when the expenses were subtracted; and repeat this formula across the flight pattern. Keep the fares so low that the flight would always be booked. By developing the demand in this new market segment, Burr felt that he had found a formula for success that could not be broken.

This approach looked promising until American Airlines used its Sabre reservation system to implement yield pricing. Through advance ticketing and other restrictions, American was able to discount seats that would have gone unsold because of People's low fares. The flying public now had a choice. They could continue to fly on People Express Airlines and deal with the chaos and the crowds, or they could make reservations and fly on American Airlines with comfort. Besides, they could fly directly and not go through Newark. The remainder of the seats were sold at full price to business people who could not plan far enough ahead to make advance reservations.

People's vision was a good one. It centered on cost cutting and motivating the workforce. Overexpansion and the lack of a marketing focus contributed to the failure of People Express. However, a third major factor was the failure to integrate technology into solving its business problems. Before its first plane left the ground, People Express managers decided not to duplicate American and United Airline's sophisticated reservation systems. Another reason People Express shied away from technological development was that the airline lacked the internal expertise to build or even buy a reservation system. In 1983, the carrier contracted with NCR Corporation to build a system to handle yield management. After 18 months, the project failed. According to Burr, the failure was due to poor communication on both sides and a lack of management attention.

Adapted from Richard Pastore, 1990, Coffee, Tea and a Sales Pitch, *Computerworld*, 7/3/89, p. 1. and Clinton Wilder 1989, Don't Blame the System, *Computerworld*, 7/3/89, p. 42.

as your firm develops a strategy that pays higher returns, other firms will flock to the industry and drive the prices and profits down. Figure 10.6 summarizes the common **barriers to entry**. One way that information systems create barriers to entry is from their cost. Consider what happens when you create a new information system that provides additional services, like banks did with ATMs. Customers soon expect all firms to offer those services. If a new company wishes to enter the industry, it will have to spend additional money to buy the computers and create the systems to offer those services. The information system raises the cost of entering the industry. A classic example of this situation was the introduction of People Express Airlines in 1981. The CEO of People Express stated that he knew the airline needed a reservation system to compete effectively with other airlines, but after raising $100 million to start the airline, top management found it impossible to raise the additional $100 million needed to create the reservation system.

As shown in Figure 10.7, computer systems might also be used to create more direct barriers to entry. For instance, as a manufacturer you could build a computer system that is tied to retail stores. The stores would use the system to place orders and to inquire about products, warranties, and delivery schedules. You might be able to forbid the stores from using the system to connect to any other manufacturers. If the stores gain advantages from the new system, they will end up placing more orders from you, and you will keep out potential competitors. However, you will have to be careful not to violate antitrust regulations.

Distribution Channels

Controlling **distribution channels** is a method of gaining competitive advantage that is similar to creating barriers to entry. The Japanese economy has long been a classic example of controlling distribution channels, although the role of information systems is minimal. In Japan, sales relationships are developed over long periods of time, and companies have many interrelationships and ties. In particular, distribution of products from manufacturers to retailers is controlled by a few large companies that are loosely organized into support groups (keiretsu). If you want to sell products in Japan, you must build a relationship with one of these companies. American executives have often complained about the problems they experience in dealing with these distributors, which creates a barrier to selling U.S. products in Japan. Although there is disagreement on the cause of the problems, the ability to control distribution channels can be an effective strategy for maintaining market share and deterring rivals. The distributors gain power through their close personal ties to the customers. For example, in Japan, most new automobiles are sold by salespeople who call on customers at their homes.

Information systems can be used to control distribution channels. As a manufacturer, you could build a computer link to the retail stores. In addition to providing faster ordering and more information, you encourage the store to order directly from your company and avoid competitors. For example, Levi Strauss, the jeans manufacturer, has installed such a system in some retail chains. Assume that you work for a competitor and you call on the retail store to convince the buyers to carry your products. Probably the first question you will be asked is whether the store can order your jeans through the Levi Strauss computer link. If the answer is no, the store manager is going to be less willing to buy your products.

Gaining a Competitive Advantage

Barriers to Entry
The additional costs of creating a sophisticated information system make it harder for firms to enter the industry. Classic case: People Express.

Distribution Channels
Control over distribution prevents others from entering the industry. Case: iTunes or Napster.

Switching Costs
Consumers are reluctant to switch to a competitor if they have to learn a new system or transfer data. Classic Case: Baxter Healthcare.

Lower Production Costs
Using technology to become the least-cost producer gives an advantage over the competition. Classic case: Wal-Mart.

Product Differentiation
Technology can add new features to a product or create entirely new products that entice consumers. Classic cases: Federal Express and Merrill Lynch.

Quality Management
Monitoring production lines and analyzing data are important aspects of quality control. Improving quality leads to more repeat sales. Classic case: Digital Equipment Corp.

The Value Chain
Evaluating the entire production process identifies how value is added at each step. Combining steps or acquiring additional stages of the value chain can lead to greater profits. Case: Qwest.

Figure 10.7

Classic cases. Several classic cases illustrate some important methods of acquiring a competitive advantage. Understanding these cases will help you identify potential strategies in other situations. They will also help you communicate with IS professionals.

Now, imagine the confusion that can result for the retail manager who wishes to sell similar products from three companies. What happens if each company has its own private computer link? Does the manager need to have three different computer terminals and learn three different systems?

Partly because of the loss of access to distribution channels and partly because of the confusion resulting from having multiple systems, attempts are being made to standardize some electronic relationships. An important component of electronic data interchange (EDI) is to define standards so that managers have to work with only one system and everyone has reasonable access to that system. If EDI does become standardized, there will be fewer opportunities to control distribution channels with information systems. However, businesses might still be able to gain a competitive edge by providing better, more sophisticated electronic services through the links. For example, expert systems might be used to provide faster responses to retailer and consumer questions.

One of the interesting aspects of the Internet is its ability to alter traditional distribution channels. In particular, the Internet is becoming the major distribution system for digital data such as music, books, video, software, and news. Some traditional organizations fear this change as a loss of control. For example, in the U.S. music industry, a handful of firms have controlled the production and distribution of most music. In 1998, the firms attempted to stop the expansion of digital music (e.g., MP3 format), but the courts did not support this interference. Consequently, it is now relatively easy for anyone to create music in a commercial format and distribute it cheaply over the Internet. The same industry-altering effects are occurring within the book and news industries. As the number of mobile devices (readers, tablets, and large-screen phones) increases, more people are switching to digital content away from traditional paper.

Switching Costs

An interesting strategic capability of information systems is their ability to create **switching costs** for your consumers. Consider the case of a brokerage firm that creates a system that enables you to manage your accounts with your personal computer. You buy and sell financial instruments and write checks against your account. The computer automatically tracks your portfolio, notifies you of major changes, and automatically sweeps uninvested cash into interest-bearing assets. At the end of the year, it prints a complete summary of your transactions for tax purposes.

Now, what happens if another broker or bank offers you the same capabilities? Will you switch to a new firm? You might, but it depends on what other incentives the company offers. If everything else is the same, most people would be reluctant to change since they incur costs to switch. For example, you would have to learn how to use the new system. Besides, you would have to reenter your investment data and program new reports and graphs. If you are one of the first firms to create a new system, the deterrence of switching costs can be a powerful tool to maintain

Reality Bytes: Control over Distribution

Sony was one of the leaders in designing and selling e-book readers; even before Amazon. Sony has its own digital book store tied into its reader. When the Apple iPad was released, it presented a challenge to Sony and other e-Book readers. Although the display quality is lower on the iPads, it is color, and it is backlit so people can use it at night without a reading light. Sony (like Amazon and Barnes and Noble), created an iPhone/iPad app that enables people to buy books directly from the Sony bookstore. In February 2011, Apple blocked the Sony app. Apple is now insisting that content must be sold through the Apple store instead of inside an application. The reason is not technical—it involves money. Apple takes a 30 percent commission on all sales through its store.

Adapted from Yukari Iwatani Kane and Stu Woo, "Apple Rejects Sony E-Book App," *The Wall Street Journal*, February 1, 2011.

Reality Bytes: Merrill Lynch Cash Management Account (Classic Case)

Until the 1970s, banks and other financial institutions were treated differently by the government than stock brokers such as Merrill Lynch. Financial institutions could not sell stocks, and there were limits on interest rates that could be paid to depositors. Brokerage companies focused on investments in stocks. In this environment, Merrill Lynch created its Cash Management Account (CMA). For a minimum sum of $25,000, investors could open a new account with Merrill Lynch. The account was similar to a bank account. The money could be placed in risk-free government bonds or it could be used to purchase stocks and bonds. The money could be obtained with minimal problems, including writing checks against the account. In short, the CMA became a bank account for medium and large investors. The primary advantage to the CMA over traditional bank accounts was that there were no government restrictions on the interest rates. As commercial interest rates rose in the late 1970s and early 1980s, huge sums of money left the banking industry and were deposited in the CMA.

Merrill Lynch used its information system to offer additional features, such as automatic transfers between accounts, overnight repurchases and sales of government bonds, and automatic investments and sales of stocks. All the investment options were controlled by individual investors. Banks could not offer these services because of governmental restrictions, and other brokerage firms did not have the information systems. This use of information technology gave an advantage to Merrill Lynch.

While Merrill Lynch was not known for other innovations, it is one of the largest financial institutions in the United States with a balance sheet comparable to Citicorp's. In 1995, the brokerage firm had 44,000 employees and operated in 31 countries. The 1994 profit amounted to 18.6 percent return on equity.

your market share. Figure 10.6 summarizes the tools to create competitive advantages as practiced by companies in the classic cases.

Lower Production Costs

In some cases, an effective strategy is to become the lowest-cost producer. If you can consistently sell your product for lower prices than your competitors do, you will have an important advantage. However, consumers need to believe that your products are as good as the competition's.

Computer systems have long been used to decrease costs. Transaction-processing and accounting systems decrease administrative costs. Robots and process-control systems can be used to control manufacturing costs. Inventory systems are used to track parts and reduce inventory ordering and holding costs. Marketing systems might be used to create better target marketing, with the advantages of improved response and lower marketing costs. Financial systems that control investments and cash flow also can result in decreased costs.

Product Differentiation and New Products

Another strategic use of information systems is the ability to create new or different products. If you can add features to your product so that consumers believe it is different from the competition, you will be able to make more money. A classic case of using technology to create a new product is portrayed by Merrill Lynch.

Reality Bytes: Postal Service Death Spiral?

In many ways, the U.S. Postal Service (USPS) appears to be in a death spiral. The number of users (mail) declines, so the company increases prices to get more revenue, which drives away more customers and the process repeats. In 2010, mail volume declined 3.5 percent from the prior year. However, 170.6 billion pieces is still a lot of mail. For the years 2008, 2009, and 2010, the volume of first class mail fell by 4.8%, 8.6% and 6.6% respectively. Typically, first class mail produces at least half of the revenue. The Post Office eliminated 105,000 jobs and reduced costs by $9 billion, but still lost $8.5 billion for the year. The agency asked Congress for permission to eliminate Saturday deliveries—essentially reducing services. The demand for physical shipments has not disappeared, but no one knows how far or how quickly the demand will drop.

Adapted from *The Wall Street Journal*, “Post Office Has $8.5 Billion Loss,” November 12, 2010.

Another classic case of using information systems to modify a product for competitive advantage came from Federal Express—an overnight package delivery company. Federal Express was the first major delivery company to track individual packages. The service places bar codes on every package and scans them every time the package is moved. By storing this data in a central database, Federal Express employees can tell customers exactly where any package is located. Besides decreasing the number of lost packages, this system provides a new service for customers. Nervous customers can use the information to determine when a package will be delivered. The information system tracks the current location of each package. When the system was created it provided a unique service to customers. To consumers, Federal Express is offering not just package delivery but also information on the location of the package. This **product differentiation** will help attract customers and might allow the company to charge higher prices.

In some cases, information systems can be used to create entirely new products or services. For example, many banks offer sweep accounts to customers who place large sums of money in their bank accounts. Variations exit, but the purpose of a sweep account is to automatically place money into higher-interest-bearing assets. For instance, you might need cash available during the day to cover any withdrawals. But if you do not make major withdrawals at night, the bank could lend your money to someone for overnight use. The bank needs a sophisticated information system to keep track of which customers are participating, monitor what limits they have imposed, and automatically transfer the money to the borrower’s accounts. (As a side note, you might wonder who wants to borrow money for just one night. Of the many possibilities, two major players are governments and large banks. Some interesting international possibilities also arise by lending across time zones.) Customers receive more interest, borrowers have access to more funds, and banks make money on the transaction fees and interest rate differentials. These accounts can be provided only by investing in new information systems.

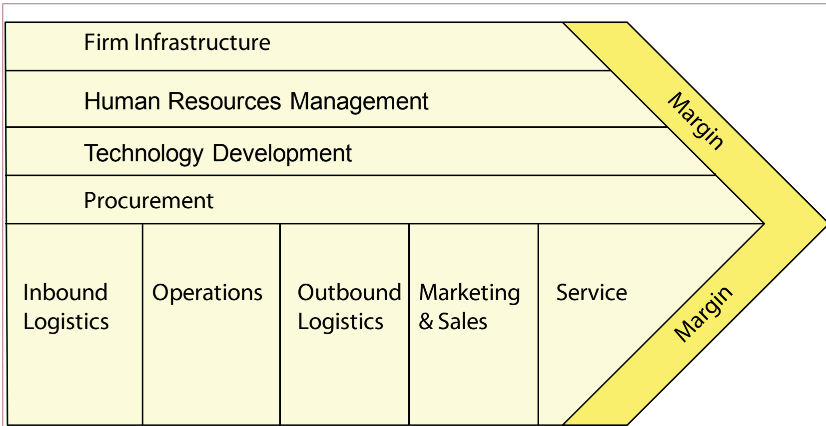


Figure 10.8

Value chain. The value chain illustrates the essential operations in a business. Every firm has operations for purchasing, production, shipping, marketing, and customer service. These processes are supported by the organization of the firm, human resources management, technology development, and procurement services. Providing services desired by customers contributes to the profit margin of the firm.

Quality Management

Firms can gain a competitive advantage by offering higher-quality products. Through the 1980s, surveys indicated that owners reported fewer problems with automobiles manufactured by Japanese firms compared with those produced by U.S. manufacturers. This difference in quality gave the Japanese firms a competitive advantage. Similarly, Motorola is one of the leading proponents of total quality management. The company is constantly encouraging its suppliers to work at improving quality through the entire manufacturing process.

Information systems have a role in improving quality management. For starters, they can be used to collect data about quality measures. If quality measures come directly from production machines, there can be an overwhelming amount of data. In other cases, quality measures might be collected electronically from your suppliers. Collecting data seems like an obvious idea, but the huge amount of data complicates the process. In many cases, manufacturers have trouble identifying the original source when a component fails. Often, just knowing which suppliers cause the most problems is a useful step in quality management. This data can also help the supplier. Failure data can be used by the supplier to pinpoint the source of problems. Since 1992, nations in the European Union (EU) have been requiring firms to improve quality by complying with the statements in the ISO 9001:2008 (International Organization for Standardization) directive. ISO 9001 requires companies to measure quality at all stages of production. Any firm that wishes to sell products or parts to firms in the EU must build an information system to monitor quality and provide information to customers.

No machine is perfect. There is always an element of error in the output. The difficult part is to determine which errors imply that the machine needs to be readjusted. Decision support systems can be used to improve quality. **Statistical quality control (SQC)** is an important tool. Several statistical calculations and graphs are used to determine whether fluctuations are purely random or represent major changes that need to be corrected.

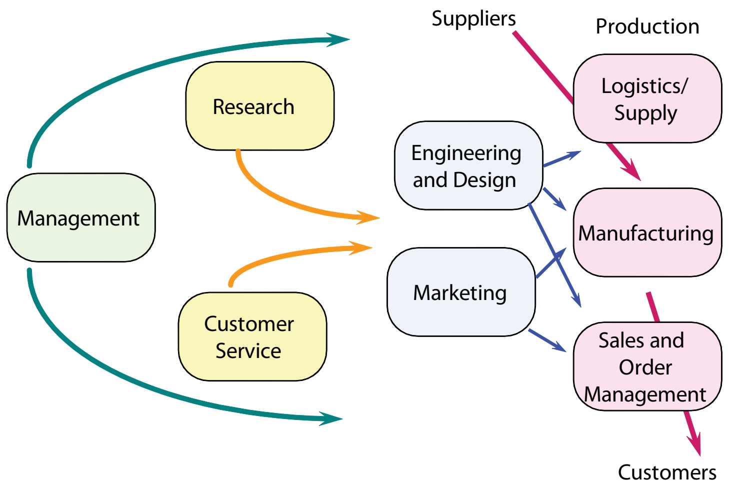


Figure 10.9

Process innovation. Production consists of the processes of supply logistics, manufacturing, and sales management. These processes are directly supported by design, engineering, and marketing. Research and customer service support all of the processes; top management organizes and controls the firm. Technology can provide innovations in all of these processes.

Expert systems also can be employed to control errors and locate the source of the problems. Consider a production line that has 50 major machines. In addition, several hundred parts are purchased from external suppliers. The final product has thousands of parts and hundreds of assembly operations. Total quality management requires that quality be monitored at each step of the process. A typical problem facing a machine operator is that a machine might stray off the baseline and need to be corrected. The operator faces several questions, such as: Which adjustment should be made? Should we overcorrect to compensate for the prior errors? Was the problem caused by this machine, or did earlier operations contribute? If corrections are made now, how will they affect other machines down the line? An experienced operator might be able to answer some of these questions. On the other hand, an expert system might be helpful at solving the more complex problems. Digital used expert systems to improve quality and cut the cost of installing minicomputers. Digital's weak performance in the 1990s also illustrates the difficulty in maintaining a competitive advantage as the market changes.

The Value Chain

One method of searching for areas that might provide you with strategic benefits is to examine the entire **value chain** of the industry. As shown in Figure 10.8, the key feature of a value chain is to examine each step of production and determine how value is added at each step. If some steps show larger increases in value than others, they will be key points to target for strategic action. The second objective of value chain analysis is to encourage decision makers to examine the bigger picture in the industry. In many cases, a firm can benefit by expanding its operations beyond its traditional activities. For instance, an automobile manufacturer (Ford) might buy a car rental agency (Hertz). Now the manufacturer can control a large consumer of its products and control the sale of the used vehicles.

Figure 10.10

Strategy requires more than a good idea. Innovative strategies often carry high risk and potentially high rewards. Unique ideas are hard to find, hard to evaluate, and difficult to sell to top management. And success can depend on careful implementation, management support, and careful monitoring.

The Search for Innovation

How can IT support the operations of the firm to provide a competitive advantage? Industry and academic leaders are constantly searching for ways to improve organizations and gain a competitive advantage. Illustrated by Figure 10.9, one method to organize the search is to examine the primary processes of the firm: research, engineering and design, manufacturing, logistics and supply, marketing, sales and order management, service, and general management. Each of these processes has its own inputs, outputs, and objectives. Analyzing them in detail enables managers to spot problems and to search for innovative opportunities.

The following sections present general ideas for each of these processes that have generated interest and some success. Most of them use technology to improve the process or to help the processes work together better. Keep in mind that in any firm, there can be many ways of improving processes. Relying on information technology is not always the best answer.

Just coming up with a new corporate strategy is difficult, but it is not enough. As indicated by Figure 10.10, an effective strategic plan must also describe the changes in the process, identify the new data needs, and describe how the information system will be changed to support the new strategy. Business strategy re-

Area	Information Technology Support
Research	Analysis and modeling, project management, workgroup support, databases, decision support.
Engineering and Design	CAD/CAM, testing, networks, workgroup support.
Manufacturing	Mass customization, links from customers and suppliers, robotics, quality monitoring, expert systems for maintenance, production databases, business integration tools.
Logistics and Supply	Just-in-time linkages, forecasts, models, links for design, transaction processing.
Marketing	Frequent buyer databases, target market and media analysis, survey design and analysis, multimedia promotion design, links between customers and design teams.
Sales and Orders	Portable computers for salesperson contact, expert systems for order customization and configuration, workgroup tools for customer support.
Service	Phone support systems, location monitoring and scheduling of service people, expert system diagnostics, databases.
Management	Enterprise information systems, links to service providers (accountants, consultants, etc.), e-mail, bulletin boards, decision support systems, personal productivity tools, workgroup support.

Figure 10.11

The search for innovation. Information technology provides many opportunities for improving the fundamental business processes. IT is used to improve communication, decrease costs, reduce design times, monitor customers and rivals, and improve customer service.

quires more study than can be provided in this book. Several books and courses study the various techniques for analyzing businesses and searching for new business strategies. The key is that the executive analysis should include an awareness of the opportunities provided by information systems. Also, the information system strategic plan needs to adapt to the organization's strategies.

It is easier to understand the strategic possibilities of IT by looking at the specific organization functions. In most situations, you will examine the organization in detail, and search for ways to apply technology to operations and support functions. Figure 10.11 summarizes the capabilities of IT to support innovation. All of these technologies are discussed in this book. The difference now is that you are specifically searching for new ways to improve an organization. All of these methods have been used in other organizations to support the various areas. Some organizations use many of these tools, others only a few. Some technologies are well-established and would hardly count as strategic in some organizations today. But, the point of the table is to summarize the possibilities to help ensure you do not overlook them in your search for ideas.

Research

Research in firms varies enormously depending on the industry and the overall corporate strategy. At a minimum, most firms at least have a product development team that is constantly searching for new products or improvements in existing products. Some companies, such as 3M, DuPont, Microsoft, and Intel, spend considerable sums of money on basic research to create entirely new products. To these firms, strategic advantage comes from being the leader in the industry with a constant cycle of new products.

IT support for research takes the form of computer analysis and modeling, statistical analysis of data, project management and budgeting, and workgroup technologies that make it easy for researchers to collaborate and share information with each other and with managers throughout the company. Data mining, business intelligence, and neural network tools can also be useful for exploring and analyzing research results. For example, many experiments in chemistry and physical sciences can be monitored and summarized by automated equipment.

Engineering and Design

Engineering and design processes are responsible for converting theoretical research into new products. Engineers establish manufacturing procedures, design new equipment, and coordinate suppliers with production. In particular, the design process must optimize the production line to minimize costs and retain high quality.

Support for engineering and design takes the form of CAD/CAM systems that make it easy to create, modify, store, and share new designs. If these systems are coupled to integrated design databases, engineers can more easily reuse prior results. Tying into production databases enables the engineers to model and test various aspects of their designs. Engineers can also be supported with expert systems that help them analyze production aspects of their designs. As General Motors engineers design new cars, software helps them improve the layout to simplify production and to use existing components. Engineers are also being supported by workgroup technologies that make it easy to share designs and receive input from teams of workers throughout the company.

Manufacturing

Four key features are critical in production: costs, speed or timing, quality, and flexibility. Competing through lower costs and higher quality are time-honored means of gaining a competitive advantage. It might not be sufficient today. Increasingly, firms are turning to **mass customization** in an attempt to gain market share. Twenty or thirty years ago, the large firms in an industry were content to build huge plants, gain economies of scale, and aim at the mass market. This approach tended to leave niches open for competing firms. The problem with this strategy is that it allows rival firms to gain a toehold, which they might use to build market share and eventually compete directly against your primary market. Today's firms are trying to shift production fast enough so that they can cover virtually all of the niche markets.

Mass customization requires an IT system that links the sales system directly to the production line and through to supply. It also involves heavy use of robotics that are configurable directly from one computer. Other uses of IT include expert systems for maintenance and diagnostics. Japanese firms have long been proponents of preventive maintenance. If you wait until a machine breaks, it is too late. Expert systems can be used to schedule routine maintenance and spot problems before they cause problems. IT systems are also heavily used to monitor quality and suggest improvements.

Reality Bytes: Artists Without Labels

Information technology has made huge leaps in the past few decades and companies have spent billions of dollars on hardware, software, and personnel. But, do companies actually gain anything from all this technology? This question is challenging to answer because of the complexity of companies and technology. One answer comes from the MIT Center for Digital Business that worked with McKinsey & Co to survey 330 U.S. public companies. An important conclusion of the study was that companies that used data and analytical tools to make decisions (instead of guesswork) had four percent higher productivity and six percent higher profits than the average. Another interesting result is that many firms are not using the technology as much as they could be.

Adapted from Andrew McAfee and Erik Brynjolfsson, "What Makes a Company Good at IT?" *The Wall Street Journal*, April 25, 2011.

Logistics and Supply

The implementation of just-in-time (JIT) inventory systems is largely credited to Japanese manufacturers. Today they are used by manufacturers worldwide. Manufacturers attempt to cut costs by holding minimal inventories. Instead, inventories are maintained by the suppliers, who deliver the products to the assembly line just as they are needed. The system can work only if the suppliers and factories are linked electronically—often there is only a one- or two-hour delay between ordering and delivery.

Suppliers are often involved in the design phase. Their knowledge is useful in identifying supply availability, costs, and substitutability of components. Sometimes, it is difficult to locate suppliers for equipment. Computer networks such as IndustryNet help firms connect with potential suppliers and identify equipment, parts, and prices.

Marketing

A well-known application of IT to improve marketing is the use of frequent-buyer databases that identify major customers. More traditional point-of-sale transaction systems can be leveraged by identifying preferences and rapidly spotting patterns or trends. At the tactical level, expert systems are used to help analyze data and perform statistical trend analysis. Geographic information systems are being used by leading firms to identify patterns and possibilities for new sales. Information systems can also be used to link firms more closely to external marketing firms for research data, communication, and development of promotional materials.

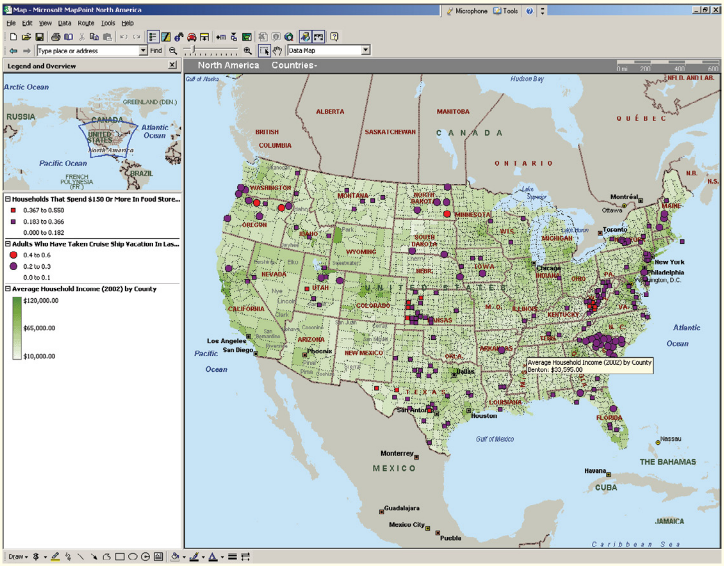
Multimedia tools are being used by leading firms to develop initial ideas for advertising and promotional campaigns. Companies such as General Motors are also using video tools and computer dissemination of video to link customers and marketing departments closer to the design team.

Social networking is an increasingly important marketing channel in many firms. If nothing else, it is important to monitor the Web for comments about your company—both to gain information and to help stop bad comments as quickly as possible. Finding ways to gather, evaluate, and leverage consumer information is critical to success in marketing.

Technology Toolbox: Locating Customers with a GIS

Problem: You need to identify locations and characteristics of your customers.

Tools: A geographic information system (GIS) helps you analyze and display relationships based on location. ESRI's ArcInfo and Microsoft's MapPoint are two leading products for displaying overlays of geographical information. ArcInfo is relatively expensive, but is widely used for large projects. MapPoint is not included with Office, but is affordable and demonstration copies are available. GIS software is designed to display basic maps, showing boundaries and major infrastructure items such as roads and rivers. You can choose the level of detail you want to see by zooming in or out. The critical feature of a GIS is the ability to display geo-coded data. Data is usually displayed using shading or different circles or other icons. You can also overlay pie or bar charts in each location, but you need to keep the number of charts relatively low to remain readable.



To further refine your strategies, you can add your own data, such as sales, factories, or competitor locations. Advanced systems also provide optimization routines that help select distribution routes.

One of the greatest strengths of a GIS is the ability to persuade others. Even if you already know the general relationships, a map is a powerful tool to convince executives. Instead of reading through pages of data, they can quickly see the spatial relationships on the map.

Quick Quiz:

1. How often does the U.s. Census Bureau update its data?
2. Why is location an important element in business decisions?
3. How many location-based pie charts do you think could be placed on a map?

Sales and Order Management

Sales and order management are often handled simply as an operations or transaction-processing area. However, in the last 10 years, several firms have used technology to gain a competitive advantage by improving the way they handle sales and orders. Frito-Lay's use of handheld computers is a classic example. The systems enable managers to more closely track their own sales, sales of competitors, and other external factors, because salespeople can enter data immediately. For certain industries, the concept can be extended further to installing workstations at the customer sites that tap into your central databases. Federal Express and Baxter Healthcare both used this technology to gain a leadership position.

Leading firms are also using expert systems to assist customers in choosing the products and options that best match their needs. These systems assist order takers and improve sales by matching customer needs. Expert systems are similarly used to improve configuration and shipping.

Workgroup technologies, e-mail, and expert systems all combine to give more power to the frontline workers dealing directly with customers. Resolving problems and meeting customer needs faster improve customer satisfaction and cut costs.

Service

Service industries and service-based processes (like accounting, MIS, and law) have their own problems and opportunities. Technology is used to support services with on-site, portable computers. These systems enable workers to have complete access to information almost anywhere in the world. Leading companies are building specialized databases to support their service workers, such as the "answer line" databases that support General Electric and Whirlpool customer service representatives.

Systems are built that monitor locations of service personnel, enabling firms to identify the closest workers to problems and to fine-tune schedules throughout the day. Complex products are increasingly being sold with internal diagnostic systems that automatically notify service departments. Similarly, companies are cutting costs and reducing repair time by building expert systems to diagnose problems.

Management

One of the more dramatic IT support mechanisms for management is an executive information system. Giving top managers better access to data allows them to identify and correct problems faster. More sophisticated models can be built to examine alternatives—especially to analyze the potential reactions of rivals in a competitive situation.

Larger firms are building electronic links to their strategic partners, for instance, by providing electronic access to corporate data to accounting and legal firms. These links enable the external partners to keep a closer eye on the firm, speeding the identification of problems and assisting them in spotting broad patterns and opportunities.

Executives are also increasingly turning to electronic conferencing tools and workgroup software, even e-mail. Executives can cover more areas and deal with more people with these systems than they can by phone or through face-to-face contact. Some studies have shown that, in traditional conversations, managers spend as much as 50 percent of the time on personal chitchat. Electronic systems

Strategy	**Skills & Resources Required**	**Organizational Requirements**	**Risks**
Differentiation	• Strong marketing. • Product engineering. • Basic research skills. • Distribution channel acceptance and cooperation.	• Internal coordination, R&D, production, and marketing. • Incentives for innovation. • Resources to attract creative and skilled labor.	• Competitors imitate. • Customers do not accept differences. • Cost is too high.
Cost Leadership	• Continued capital investment. • Process engineering. • Continuous quality improvement. • Tight supervision of labor and costs. • Products designed for low-cost production. • Low-cost distribution.	• Tight cost control. • Frequent, detailed cost reports. • Highly structured organization. • Incentives based on quantitative measures.	• Competitors imitate. • Technology changes. • Lose production or distribution advantage.
Customer-Supplier Links	• Influence with partners. • Communiation channels. • Standards or agreements.	• Flexibility to respond to customers. • Service culture. • Ability to adapt to emergencies.	• Security threats. • Changing standars. • Competitors copy with more links.

Figure 10.12

Implementing strategy can be difficult, costly, and time consuming. Firms generally choose one primary strategy and then build the resources and shape the organization to best support that strategy.

(although they might be less personal) tend to be more efficient. On the other hand, some companies have been restricting employee access to electronic networks (especially the Internet) because they waste too much time on personal communications.

Another approach taken by management is the move toward standardization: the effort to make all jobs similar, routine, and interchangeable. By reducing jobs to their most basic level, they become easier to control and easier to support or replace with information technology. Franchises make good use of this concept. At the same time, management jobs in some companies are being reformulated as teams of knowledge workers. In the past, managers worked on fixed tasks within the corporate hierarchy. Today, you are more likely to be hired for your specific skills and knowledge. As the needs of the company change, you will work with different teams at solving problems and creating new products and services. Personal computers and client-server technologies are often used to support these management teams. Instead of relying on one central computing facility, each team has its own set of resources, which are shared over networks throughout the company.

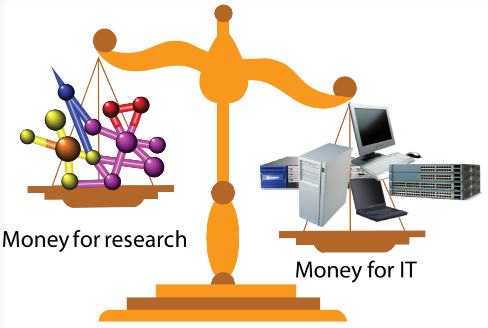


Figure 10.13

Dangers of strategy. When developing and choosing strategies, you must always remember that innovations can be risky and often carry high capital costs. Although it may be exciting to spend millions of dollars on technology, it can destroy the firm if you do not have enough resources to support research and operations.

Costs and Dangers of Strategies

Why is it so difficult to convince management to make strategic changes? What are the risks of strategic decisions? Strategic uses of information systems can be seductive. There are many interesting cases in which companies have created innovative information systems. Inventing strategic alternatives requires a considerable amount of creativity. It is easy to get caught up in the excitement of designing new approaches and to forget about the risks. Evaluation of any project requires weighing the risks against the potential gains. Although it is often difficult to measure the potential gains and risks, it is important to consider all consequences. By their nature, strategic changes can alter the entire course of the firm. Figure 10.12 summarizes the skills, organizational effects, and risks involved with several strategies.

Robert Morison and Kirtland Mead ("A Hard Look at Strategic Systems" 1989) pointed out that it is easy to misinterpret the various classic cases regarding strategic use of technology. For example, in many cases, the true strategy does not lie in the computer system; instead, the gains came from changing the way the business operates. For instance, the gains experienced by American Hospital Supply (Baxter Healthcare) came about because they improved the way their customers (hospitals) handled supplies and inventory. The computer system facilitated this change but was not necessarily responsible for it. In other words, rather than search for a killer strategic computer system, it is wiser to identify ways to improve the overall business, then ask how technology will support that change.

High Capital Costs

One of the important considerations in strategic analysis is the cost. Strategic changes often involve implementing new technology before any of your competitors. Yet new technology tends to carry high costs. Manufacturers of technology may not have reached economies of scale, and they might have monopoly power over prices through patent rights. Furthermore the IS teams will have less experience with the technology, so it will take longer to implement and may result in missteps and require additional testing. For instance, Morison and Mead (1989) report that "it took six years and $350 million before American Airlines' Sabre travel agency reservation system started paying off." As Figure 10.13 implies, these costs might take away money from other projects.

It can be difficult to estimate the cost of major projects, especially when they involve new technologies. There are many examples of MIS projects going over budget and beyond deadlines. Moreover, strategic projects often require major capital outlays up front, but increased revenues do not appear until much later.

A big question with new technology is trying to decide when it should be implemented. There is an inherent conflict. If you offer an innovative service from the technology before your competitors, you can gain a competitive advantage. However, if you wait, the costs will be lower. In making this decision, you will also have to guess what action your competitors will take.

When the Competition Follows

Another difficulty with strategic systems is that much of the advantage comes from creating a service that is not offered by your rivals. Once you introduce the service, your rivals will watch the customer response closely. If the customers begin to switch to your firm, your rivals will undoubtedly create a system to offer the same services. At that point, you lose most of the competitive advantage. Even worse, you might end up with an escalating "war" of technology. Although the competition is good for the customer, the increased expenditures can cause problems for the company if the ideas do not work as well as you expected. In this aspect, strategy is similar to chess: you must plan for multiple moves ahead of time.

The gains to technology occur from when you first implement the strategy to the point that your rivals follow. For example, almost all of the major overnight delivery services now provide the ability to track shipments. If the system is easy to create, you may not gain much. However, it is likely that customers who switched to your firm will stay, so you can gain a larger share of the market.

On the other hand, if your strategic ideas do not pay off, your rivals will gain, because you will likely lose most of the money invested in the project. Some firms use this tactic to great advantage, by using a fast-follower strategy. They allow smaller firms to take the risk and experiment with new technologies. If the project succeeds, the large firm steps in with more money and more clout and creates its own, improved version. About the only risk it takes is that the smaller firm might become successful enough to grab a serious share of the market. But, if the large firm is big enough, it can often buy out the smaller rival and integrate the technology with minimal risk.

Changing Industry

An intriguing problem that can arise is that even if your strategic project succeeds, the company might lose because your project has changed the industry. Consider an insurance company that sells software to companies to allow them to track insurance deductions and payments to workers. The insurance company decides that it can add a program to compute payroll, so the companies could drop their existing payroll software. These features appear to give the company an edge over its rivals in the insurance industry. The problem is that there are many more companies that create payroll software, and one of them is an 800-pound gorilla (ADP). It is relatively easy for these payroll companies to add insurance capabilities to their existing software. The actions of the insurance company encourage

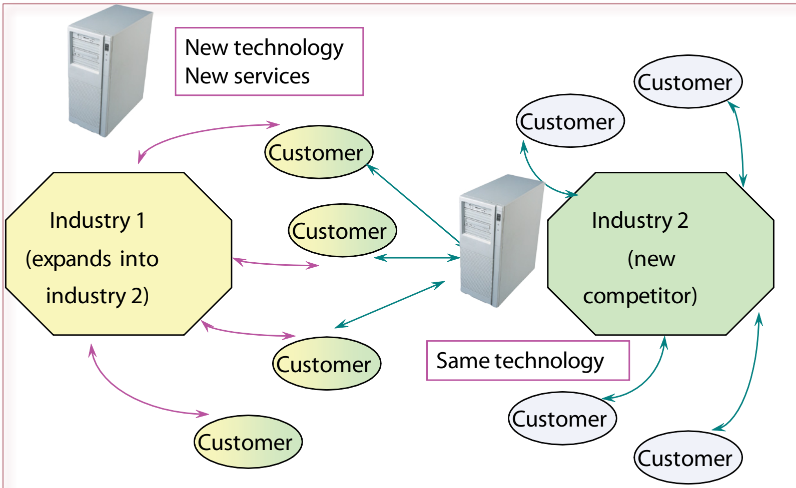


Figure 10.14

Changing industry and government intervention. A complication with strategy is that it might alter the industry. A firm in Industry 1 might use IT to attract customers from a different industry. Because of this expansion, the firm gains new competitors (from Industry 2). While competition is often beneficial, you must thoroughly analyze the effect of the new competition before embarking on changing the industry. In a related manner, sometimes changes in government regulations alter relationships between industries, as in the telephone and cable TV markets.

the payroll software firms to move into the insurance market. As illustrated in Figure 10.14, the insurance company suddenly has hundreds of new competitors and could lose customers.

Sharing Data

One common technique in strategic systems is to share your data with customers and suppliers. Two questions arise from this situation. First, do you really want suppliers and customers to have access to the data? Second, can you control their access to protect other data? Security and control issues are examined in detail in Chapter 5. The main point to think about here is what might happen as your customers gain access to your data. The process of protecting the rest of your data becomes more complex. Consider the situation of a supplier to General Motors. To save costs and improve communications, GM wants you to connect your computer to the GM factory computers. GM intends to use the links to place orders, monitor quality data, and track shipments. Are you willing to give GM access to your computer? Can you control the information that the large corporation is allowed to see? Maybe when checking on their orders, GM will also be able to determine how much you are producing for other companies. Or maybe GM will gain access to your supplier lists and raw material prices. Even if the GM managers are ethical and do not reveal this data to anyone else, you still might worry. What happens when you have to negotiate prices with GM the next time? If the corporation has access to your data, you might be concerned that it could influence the negotiations. Figure 10.15 illustrates the need for security systems that will enable you to control the access to your data.

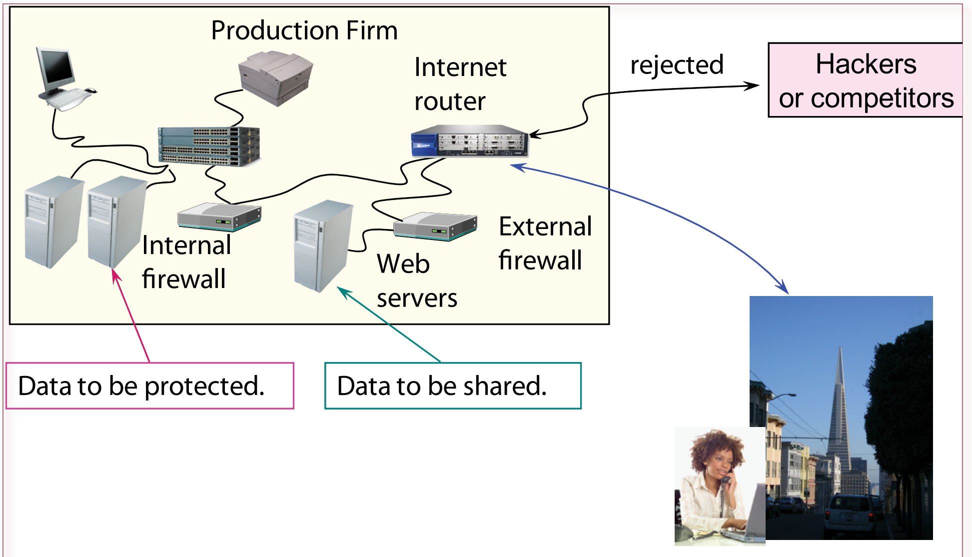


Figure 10.15

Security complications. Improving communication and sharing data are common themes in using technology for competitive advantage. This need to share data with outsiders makes it more difficult to protect your internal data. Some data you will want to share; other data must be kept secret. Security systems can provide some protections, but the more outsiders who are involved, the more difficult it is to provide adequate security.

Government Intervention

You have to be careful when considering strategic maneuvers. Many potential strategies violate **antitrust laws**. For example, many barriers to entry are illegal, as is price discrimination. In fact, attempts to monopolize a market are forbidden by the Sherman Antitrust Act. Price fixing and other forms of collusion are also outlawed. Information system agreements between competitors could be scrutinized by the Justice Department or the Federal Trade Commission. More recently, the European Union has become a major player in evaluating mergers and antitrust complaints. Even if a company is largely based in the U.S., major sales in the European Union can make the company subject to European rules and procedures.

If government agents choose strict interpretations of the laws, it could complicate many information system issues. For instance, firms might be discouraged from forming consortiums that define standards. Agreements to share disaster backup facilities might be outlawed. Computer links to customers might be seen as limiting competition. So far, the U.S. agencies have allowed all of these activities to proceed without interference. However, there is always the chance that other nations or different political administrations will view the issues differently.

From the 1980s through the 2000s, the government was relatively lenient about antitrust issues, including those regarding information systems. However, one interesting case arose with the airline reservation systems. For many years, American Airlines and United Airlines had the leading reservation systems. Other airlines could list flights on the systems, but they had to pay money for each ticket sold through the system. A conflict eventually arose because the airlines

Reality Bytes: Borders Battles for Life

Borders Group is the second largest bookstore chain in America, behind Barnes and Noble; and not counting Amazon. The switch from print books to digital caught Borders flat-footed. The company was late to the digital marketplace. Borders purchased a stake in Kobo Inc., a Canadian e-book retailer, and launched an online bookstore in mid-2010. Albert Greco, a researcher of the book industry estimated that in 2009 Borders had a 10 percent share of the retail book market. Borders said that it hoped to control about 17 percent of the e-book market by mid-2011. In early 2011, Borders began closing many of its retail stores.

Adapted from Jeffrey A. Trachtenberg, "Borders Group Launches e-Book Store," *The Wall Street Journal*, July 7, 2010.

that created the system programmed it to list their flights first. Flights from other airlines were often listed on separate screens, so travel agents and customers were encouraged to choose flights from the airline that built the system. Although this mechanism did not directly violate antitrust laws, Congress decided to pass a new law, making the practice illegal. Lawmakers decided that as long as the other airlines had to pay for access to the system, everyone should have an equal chance at being listed first. The point is that even though the initial action was not illegal, Congress has the ability to pass new laws and remove the advantages, so you cannot assume that the benefits will last.

The Role of Economics

Why did so many dot-com firms fail? Do their failures mean there is no viable Internet strategy? The main lesson from the failures of the early dot-com firms in 2000 and 2001 is that no matter what anyone tries to tell you, to succeed in business, you must make a profit on operations. The second lesson is that it takes time to acquire loyal customers—longer if you want to change the world. Many of the early e-commerce managers felt that to become the dominant player, they had to be the first and biggest firm. So their primary strategy was to sell products below cost and spend huge amounts of money on national advertising. The advertising was successful at attracting investors, whose cash kept the firms alive for a year or so. But when the sales failed to generate profits, there was no way to keep the companies running.

The advertising strategy also created an interesting domino effect in the early industry. By pushing the importance of name recognition (and a good domain name), many of the early firms were able to survive by attracting advertising money from other firms. For example, Excite was a leading Web-portal firm. With its easy name and relatively popular search engine, many people used the site on a regular basis. Based on the number of people visiting the site (known as eyeballs), Excite was able to sell advertising space on its pages to other Web firms. Over 80 percent of Excite's revenue came from advertising. As the other firms in the industry fell apart, they stopped their advertising spending and Excite's revenue plummeted. Many other firms faced the same problem, and the chain reaction caused hundreds of firms to fail.

Clearly, Web sales and Web advertising are here to stay. Many firms make money from sales of products, services, and advertising. Yet, many firms still face difficult decisions about how to draw those lines. The newspaper industry is one that is facing difficult questions. In the early days, many magazines and newspapers attempted to charge for access to their sites. Gradually, most of them dropped subscriptions and relied on advertising revenue as well as sales of traditional paper-based versions. A notable exception was *The Wall Street Journal* which focused on creating quality content for a fee—even online. But, as print subscriptions dwindled, newspapers began creating "pay walls" where people had to subscribe to see content online. The situation is an interesting strategic problem—which could mean life or death for many companies. The challenge is that to sell online advertising, the sites need to attract a large number of unique visitors. But, charging for content has the potential to drive away readers who will be inclined to find free resources. So, a newspaper would lose money from advertising and not gain much money through subscriptions. Yet, if print subscriptions and print advertising continue to dwindle, how can a newspaper cover its costs?

Television and radio stations have been able to survive on the basis of advertising revenue. Some Web sites (notably Google), became wealthy through advertising. But, is there room for thousands or millions of sites to succeed based solely on advertising?

The strategic options in e-business are increasing as new tools are created, wireless capabilities improve, and people begin to adopt connectivity as a way of life. At this point, there is no single answer, which makes it even more important that you carefully define your goals, analyze the profits, evaluate your competition, and build a creative business plan.

Challenges of Strategy

How do you convince an organization to change strategies? This question is probably the most difficult question any upper-level manager will face. Even when you join an organization in an entry-level management position, you will quickly see the challenges presented to new ideas. Most people and almost all organizations resist change. Organizations develop a method of operating that works. It might not be the perfect answer, but it was developed over many years and hardened through experience and competition. The method must have been reasonably successful or the company would not have survived. But, is it the right strategy for the future? And, if you think you have a new strategy, how will you convince people to adopt it. Keep in mind that new strategies cost money and an organization usually faces multiple options for strategies. How can you prove your ideas have merit and will work? The challenge is even higher if the risk of failure is a large loss or a loss in market share.

Information technology solutions can be even harder to sell to top management. Few managers truly understand technology. Most have experienced problems with technology failures—particularly leading edge technologies. Most large companies have encountered the delays and frustrations of trying to develop and implement new technologies. Managers have become cautious about being the first organization to try new technologies. Managers also know that the price of new technology is often high and tends to decline rapidly. Being the first person to adopt new hardware usually means that you are paying more money than anyone else. Consequently, many people choose to wait and see which technologies will succeed and wait for the price to drop to levels that reduce the risk.

Technology Toolbox: Analyzing Businesses

Problem: You are presented with a business problem to solve.

Tools: You need an analytical methodology to evaluate the problem, focus on the causes, and identify appropriate solutions. If the situation is based on business processes, you can use the data flow diagram techniques to show how the firm is organized and how data is supposed to move. Because it is a graphical approach, it is good for spotting the cause of problems and for communicating relationships to others. You can also adapt database and object-oriented tools to help you understand design details for data-intensive problems. Ultimately, every manager needs to develop a methodology for approaching business problems and cases. When you encounter a new situation, where do you start?

Foundation	Business Plan	Expectations
Solve the right problem Choose the right tools Divide the system Make a decision Consider the consequences Detail the implementation	Problem description State facts and problems. Identify most important problems and causes. Plan Describe the new system. Detail how to implement the plan. Provide a contingency plan. Advantages Show how your plan will solve the problems. List additional advantages and strategic effects.	Measurable goals Financial implications Effect on human resources Strategic effects Critical success factors Potential risks

The important first step is to solve the right problem. Most businesses encounter multiple problems. Often, you see only the symptoms, and you need to trace back to the cause. This work requires detective and diagnostic skills—which are usually acquired through experience with cases and real-world problems. Once you have identified the root problems, you have to choose the correct tools. There is an old saying: When all you have is a hammer, everything looks like a nail. Make sure you examine all of the available tools before pounding away.

A good starting point for developing a structure is the old debating approach: problem description, plan, and advantages. Use the problem description to identify the most important problems and the cause of the problems. This section must clearly communicate the need for a change. The plan itself must be detailed and as specific as possible. You should include implementation issues, costs, and alternatives or contingency plans. Be sure to include a section that explains how your plan is going to solve the problems you identified.

Your analysis needs to identify any measurable goals and financial implications. If the goal is to reduce costs or save time, quantify those numbers. Consider the effects on human resources. Will the technology reduce the number of employees? Will you retrain employees, or need to hire more within the MIS department? What are the critical success factors for the firm and the project? What are potential risks of the project? Such as cost, alienation of employees or customres. Identifying these risks up front makes it easier to find ways to mitigate them later.

Quick Quiz:

1. Why is practice so important in learning to diagnose business problems? Where will you get this practice?
2. Where do you place the expectation elements in the business plan?
3. How is the problem description different for a business case compared with an actual business problem?

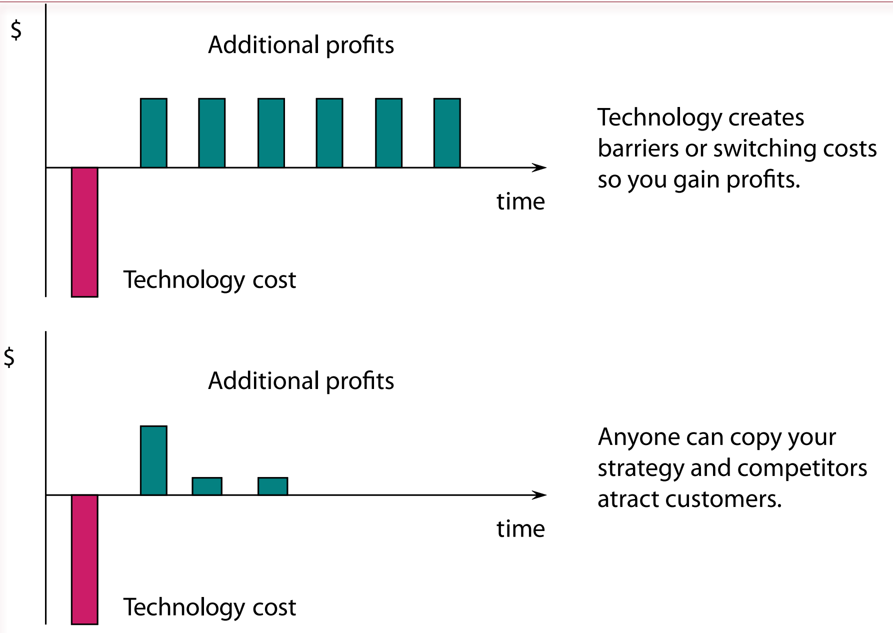


Figure 10.16

Sustainability. If technology does not enable you to keep customers and profits, rivals will follow and you will not earn enough money to pay for the technology cost.

Sustainability

Remember that to be successful a strategy needs to create a barrier to entry. If you spend large amounts of money on new technology to gain market share, you need to be able to sustain an increase in profits for a long enough time to recover your costs. As shown in Figure 10.16, if you spend the money and your rivals immediately follow, everyone ends up with higher costs and no additional profits. This argument has been made many times over the years as a reason to avoid strategies involving technology. It can be difficult to determine if the argument is legitimate or if it is merely an excuse to avoid change.

Nicholas Carr explored these ideas in an article in the *Harvard Business Review* in April 2003, claiming that IT no longer has a strategic benefit. The thrust of the argument is that technology prices have declined so far that IT no longer provides a barrier to entry. Any firm can almost instantly copy anything you do. Any short-term advantage you might gain from technology is not sustainable. In fact, most information technologies today can be purchased as services from various firms. Since the computing hardware and software are readily available to any organization, it will be difficult or impossible to use it to gain a competitive advantage.

Many aspects of this argument are true. Rarely is the information technology the source of a competitive advantage. Instead, the benefits arise from how an organization applies the technology to solve problems and improve the management and decision making of the firm. The use and application of technology depends heavily on the people and management of the organization. As a weak analogy, you could give guitars to 1,000 people, but only a few of them would ever become

Reality Bytes: USA Today: What is a Paper?

USA Today was one of the first national newspapers—certainly the first to target general news, and to use color. At one point, it had the largest newspaper circulation in America. By 2010, the company hit serious problems. The biggest two: Circulation was plummeting and advertising revenue had collapsed. On finally recognizing the shift in the way people obtain news, the paper began downsizing, eliminating 130 jobs (9 percent of its employees), and shifting its focus away from the printed edition. The goal was to create an organization that could deliver news through the Web site and react quickly to changing preferences. Over time, USA Today had become stale. The environment changed to online, instant access to news, entertainment, and sports; but USA Today had made few changes. The company was finally beginning to understand the need for change. But, the task is arduous. Craig A. Huber, an analyst at research firm Access 342 noted that "I don't blame them for tinkering with the model, but everybody has been trying to do that. They have to restructure. They don't have a choice in this quickly evolving media landscape."

Adapted from Jeremy W. Peters, "USA Today to Remake Itself to Stress Digital Operations," *The New York Times*, August 27, 2010.

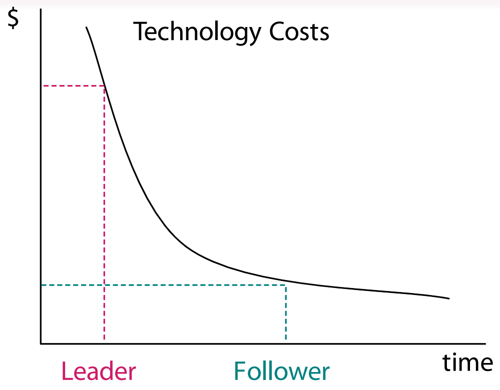
proficient musicians and only a couple would be able to form a successful band. Hardware and software are not enough to provide a competitive advantage. You need an organization that has the knowledge and willingness to change and use the new technologies to alter the way it operates.

Examine the classic cases in detail and you will see that the gains arose from the way the technology was applied. American Hospital Supply/Baxter Healthcare used the technology to provide better information and lock in customers. Merrill-Lynch and FedEx used the technology to create new products and services. American Airlines used its giant databases to provide knowledge to make better pricing decisions. Even if you can copy the hardware and most of the software, can your organization achieve the same benefits?

Consider groupware as a relatively new technology. Any organization can install SharePoint servers at minimal cost in terms of hardware and software. Yet, even today, ten years after the introduction of the technology, how many have done so? How many are effectively using the technology? And, how many have altered their operations to take advantage of the communication and teamwork features to reduce costs, find new solutions to problems, and add flexibility to the organization? The technology is definitely important, but ultimately it is the management and workers in the firm that must adopt the technology to alter the operations and gain the full benefits.

Leader or Follower

Another often-debated aspect of strategy is the importance of the **first-mover** advantage. The concept comes from game theory, which is often used to study rivalry. In some situations, the organization that adopts a strategy or technology first will be seen as the leader and will acquire customers who will then be reluctant to switch back. Even after a competitor adopts the same technology, the customers will stay with the first firm. The first mover might also gain a reputation for being innovative, which might attract additional customers. Ultimately, the first-mover



Leader	Follower
Lock in customers	Reduced risk —standards
Reputation	Lower cost
Lock in technologies	Supplier experience
Experience	
Lead for next step	

Figure 10.17

Leader or follower. Technology costs decline over time, so leaders pay a higher price for technology. In good situations, the leader gets to lock in customers, build a reputation, and gain experience. It is also primed for the next step. The follower reduces risk by picking the technologies that survive and paying a lower cost for hardware and experienced suppliers.

advantage depends on the customers and the nature of the innovation and the industry. If the technology increases the switching costs, then the value of being the first firm to adopt a technology is higher. With each strategic idea, you will face arguments over the potential strength of being the first adopter.

The issue of being a leader or a follower is critical with information technology—because the costs will drop over time. As shown in Figure 10.17, if you choose to wait, you lose the first-mover advantage, but costs decrease the longer you wait. Additionally, any technology strategy carries risks. By waiting, you can let some other firm take the risk, while you wait to see if customers actually care about the new services or options available. Remember that at any point in time, you have a choice of several technologies. It is difficult to guess which technology will succeed and become a standard.

Many times you face this same decision as a consumer. Look at television and cell phone technologies. If you adopted HDTV, 3D, or 4G cell phones early then you paid a relatively high price for the technology. Plus, content and access were limited because most people had not yet switched. If you can manage to wait a year or two, prices inevitably drop (or weak technologies disappear), and you can save money by not being the leading adopter. Fortunately, consumers do not have to worry about making money or beating other consumers with these technologies, so the decision is quite a bit easier for them than it is for businesses.

Large firms can be reluctant to be leaders. Their size makes it difficult to change operating procedures, and tends to add bureaucracy that delays making decisions. It is often easier to watch small competitors and let them adopt a technology first. Even if a small competitor is successful, the risk is minimal because the number of customers affected will be small. Once a technology is seen as useful and the prices drop, the big firm can use its size to purchase the technology, fix any perceived problems, and generate a marketing campaign to sell the new services to the rest of the world. Because it is difficult to patent the use of information technology, this approach is generally legal; and most customers will never know about the original small firms that tested the technologies. In some extreme cases, large companies have spun off smaller firms to test experimental technologies. In other words, if you cannot find a smaller firm to do the testing, you can create your own small firm to test a technology. Companies with many small stores, such as franchises, often adopt a similar approach by selecting one or two stores to test new products and services on a small scale.

Choosing to be a leader or follower in information technology is one of the biggest strategic decisions an organization must make. The choice does not have to be all-or-nothing. It can be applied differently to various divisions or even types of technologies. Also, the decision needs to be revisited periodically to correct for changes in technology, the business environment, and the competition.

Change Agents

Organizations need rules and methodologies to function. Basic day-to-day decisions need to be handled at the customer and operations level. Without rules and procedures, all decisions would filter back to the top levels of the organization and it would take forever to get anything done. But the drawback to rules and procedures is that everyone is reluctant to change them. The larger the change, the more difficult it will be to get it accepted and implemented. More importantly, organizational change does not happen by itself. **Change agents** are people or events that cause an organization to reevaluate its rules and procedures. When a person is the change agent, that person often becomes the champion for the new ideas. However, change agents are rarely appointed and tend to gain prominence by random chance. In theory, you could appoint someone to be a change agent—continually searching for new ideas and technologies and bringing them to the attention of everyone else. But, it would likely be a frustrating job, and the person would likely get blamed for a lot of problems. On the other hand, some people like to try new products and new ideas, and other people naturally turn to them for advice and recommendations. These people are often natural change agents—simply by providing information and experience to others.

Economic events can be natural change agents. Many of the classic cases were driven by economic changes. These changes opened the way for new business opportunities and made it possible for firms to expand or move into new areas. For example, Merrill-Lynch altered the entire world of banking by using technology to offer a new type of account to customers. But, this account was wildly adopted because of the unprecedented high interest rates and the government restrictions imposed on commercial banks. Merrill-Lynch had the technology and the management insight to take advantage of these changes. Similarly, American Airlines was driven to adopt yield pricing by the emergence of People Express as a new competitor—because of the relaxation of government regulation in the airline industry. American Airlines had the technology and data in place for several years, but felt no need to adopt it until pressured by this external change agent.

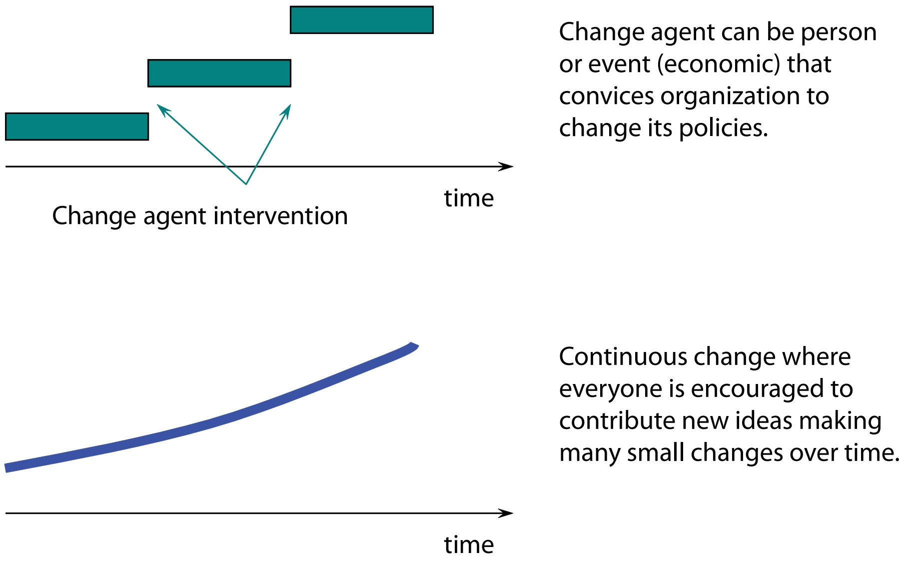


Figure 10.18

Change agent. Most organizations resist change and alter procedures in jumps when a change agent forces them to. Some organizations encourage employees to contribute new ideas and adopt change regularly, leading to continuous improvement through small changes.

As shown in Figure 10.18, most large organizations tend to resist change, causing them to adopt ideas and technologies in lumps. This approach might be useful because it minimizes day-to-day disruptions. However, it tends to make the firm a follower instead of a leader, and the changes that are eventually implemented might be more disruptive than necessary. Yet, few firms have the flexibility to make continuous changes. On the other hand, continual evaluation and adjustment are hallmarks of managing for quality. In these organizations, change and innovation are encouraged and rewarded. Each approach has its strengths and weaknesses, and again, the choice of how to identify and adopt change is a strategic management decision. Just be sure that you consciously adopt the strategy, and not fall into a choice by inaction.

Cloud Computing

Can cloud computing provide strategic advantages? In many ways, cloud computing is an indicator that many aspects of information technology have limited power as a strategic tool. One goal of cloud computing is to reduce fixed costs and to make it easier for more firms to implement the same technologies. When even small companies can implement the same technologies as large companies, it is going to be difficult to use it for a competitive advantage. This statement does not mean that technology is unnecessary. On one level, it means that firms have to at least experiment with every possible technology to see how it might create a competitive advantage. On a broader level, firms can still gain some benefits to technology if the workers and managers are better at applying it to solve problems in unique or more efficient methods.

These concepts echo many of the fundamental ideas of strategy. Simply adopting a specific technology rarely provides a competitive advantage. Instead, firms need to find a concept or new way of doing business. Technology provides the means to create these new methods or concepts. And it requires management creativity to find and efficiently apply these solutions.

On the other hand, powerful technology available at low costs and with a global reach enables firms to experiment and innovate at low costs. Firms that emphasize creativity and design could use the cloud computing technologies to continually adapt and lead the way with new products and services. In particular, services can be tailored to ever-changing regions. Yes, other firms could follow, but by then the leader will have moved on to something new. In a sense, creativity becomes a competitive tool that can be amplified with information technology.

Summary

Information systems can provide benefits beyond traditional cost saving. Competitive advantages can be gained by creating barriers to entry and gaining control over distribution channels. Using information systems to build ties to suppliers and customers can provide lower costs and better quality products. Computer systems also provide incentives for customers to remain with your company if they incur costs of learning new systems and transferring data when switching to a competitor. Information systems can also be used to differentiate your products from the others in the marketplace. Similarly, innovative services offered with the help of technology can entice customers and expand your market.

You can search for competitive advantages by examining Porter's external forces of rivals, customers, suppliers, substitute products, and new entrants. You can also search for strategies in research, engineering, and design. In manufacturing, you can look for ways to decrease costs and improve logistics. In marketing, potential gains can be found in better understanding of customer wants, as well as sales and order management. Services can be supported through better information flows and workgroup products. Management can be helped with better data and better decision tools. The government also strongly affects organizations and strategy, but finding IT interactions with the government is relatively difficult.

Strategic systems face many risks. They tend to be expensive and difficult to create. Any gains created may disappear when competitors pick up the technology and imitate your offerings. In addition, making strategic changes to your firm might alter the industry, which might adversely affect your firm. And if these problems are not enough to discourage you, remember that attempts to monopolize a market are illegal, so you have to make sure that your plans do not violate governmental regulations.

A Manager's View

With increased competition, every manager is being asked to identify ways to improve the company and find an advantage over the rivals. Gaining a competitive edge is not easy. Examining the entire value chain is a useful place to start. Information systems can provide data and evaluate models to help you identify strategic applications. Information systems can also provide direct advantages by creating a barrier to entry, gaining control over distribution, cutting costs, improving quality, and improving ties between suppliers and customers. Choosing an effective strategy is a critical task in e-business. Creating a plan and successfully implementing it are critical steps in strategy.

Key Words

antitrust laws
barriers to entry
change agents
distribution channels
external agents
first mover
Five Forces model
mass customization
product differentiation
rivals
statistical quality control (SQC)
switching costs
total quality management (TQM)
value chain

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Boston Consulting Group	www.bcg.com
Booz Allen & Hamilton	www.bah.com
Deloitte Consulting	www.deloitte.com
McKinsey & Company	www.mckinsey.com

Review Questions

1. If an industry has four large firms versus a thousand small firms, is it easier or harder to create strategies?
2. Why is strategy so dependent on external agents?
3. What are the risks and costs of strategic implementations?
4. For a large manufacturing firm, who are the customers? How many different types of customers can there be?
5. Why are barriers to entry important to gain a competitive advantage?
6. How does control over distribution channels give a firm a competitive advantage?

7. How can information systems be used to gain control over distribution channels?
8. What are switching costs, and how can they give a company a competitive advantage?
9. How can information systems be used to enhance product differentiation and create new products?
10. What role is played by information systems in improving quality management?
11. Within management, how can information technology provide a competitive advantage?
12. How do antitrust laws make the role of IT more important in finding a strategy?
13. Is it possible for a cloud computing application to lead to a strategic advantage?
14. What are change agents and what is their role in the adoption of new technology?
15. How could social networks be used as a strategic tool by a manufacturer?

Exercises

1. Choose one large firm and read the annual report (www.sec.gov). Identify the primary strategic directions and which of the main techniques it uses to gain a competitive advantage.
2. How long can firms maintain an advantage using an information system? Research one of the classic cases and find out how long it took for the competitors to implement a similar information system (for example, Merrill Lynch and its Cash Management Account, American Airlines and the Sabre System, Levi-Strauss and its Levi-Link ordering system, or Federal Express and its tracking system). Find out when the system was implemented, identify the competitors, and find out when they implemented similar systems. Did the original company continue to update its strategy? Collect data on sales and profits for the firms to see whether there were major changes.
3. Pick an industry. Find two firms in the industry—one a technology leader, the other a follower. Get the financial information on those firms for the last five years. Find analyst summaries of their operations. Compare the two firms. Are there differences in finances, operating methods, or customers?
4. Choose an area of management, such as marketing, manufacturing, or logistics. Find an example of a firm that you believe is doing a good job applying IT in this area. Briefly explain how this usage could provide strategic benefits to the firm.

5. Choose one of the IS techniques to gain a competitive advantage. Identify a firm (not one of the examples in the chapter) that is using that method. Briefly describe the financial position of the firm and how it is using information systems.

6. For each of the following firms, identify the primary strategy of the firm (such as cost, quality, customer links, and so on).

   a. Wal-Mart
   b. Toyota
   c. Apple
   d. Kohler
   e. Yelp
   f. Pfizer
   g. Starbucks
   h. General Motors
   i. Red Bull

7. Has the Internet changed the distribution of songs? In particular, is it easier or harder for small labels and independent groups to get their music heard and sold to consumers?

8. Examine the market for tablet computers starting with the Apple iPad. Identify how the various companies introduced new features and how the others responded. What did Apple gain by being the first mover?

9. How could an exercise gym use information technology to gain a competitive advantage?

Technology Toolbox

10. Using a GIS tool, compare the sales for Rolling Thunder Bicycles against population and income.

11. Find at least two Web sites or news reports that use Google maps to highlight geographic information.

12. Create a map with Microsoft MapPoint or Google maps and insert markers for the headquarters of at least five companies.

13. Choose a company case at the end of one of the chapters in this book. Perform an initial business analysis of the company. Focus on identifying the major problems faced by the company and the cause of those problems. Identify the primary level of the problem (operations, tactics, or strategies).

14. Select a company in the Fortune 500 (or Global 1000). Get some basic background information on the company and read its latest annual report. Using Porter's framework, identify its primary rivals and the level of rivalry. If they exist, identify major customers and suppliers and discuss the sales methods used by the organization. Discuss any potential competitors or substitute products that might arise in the near future. Describe any barriers to entry that might keep them out.

Teamwork

15. Each team member should read through at least two industry cases in the chapters of this book. Identify whether the firm is a leader or a follower in terms of strategy and technology. Compare each firm's financial data to that of the industry (for example, by sales and number of employees). Combine the individual analyses and summarize them. Identify any patterns you might see. For example, do the larger firms tend to be leaders or followers in technology?

16. Choose a firm that provides reasonable amounts of management information (such as a local firm or a well-documented public firm). Have each team member choose one area (research, engineering, marketing, and so on). Identify the strengths of the firm in the area. Create a short plan to improve the company's use of IT within that area. Make sure the usage fits with the overall strategy of the company.

17. Choose an industry. Assign each team member to investigate a level within the production chain. Each person should identify the tasks that occur at the specified level along with the major firms. Identify the rivalry and any dominant firms at each level. Identify the use of IT at each level and any ties across levels. Combine the results and briefly discuss where on the chain you would prefer to enter as a new firm.

18. Choose a large firm (perhaps an automobile manufacturer). Use the annual report to identify the financial condition of the firm. Use the management letter to identify the basic strategies of the firm. Identify the firm's primary competitors. If possible (try searching MIS magazine Web sites), identify the technology level used in the company.

19. Research the rivalry and strategies being pursued by Amazon and Barnes and Noble. Look at market share and service plans and pricing. What are the short-run and long-run strategies of each company? Is one firm stronger than the other?

20. Each person should find a company that has used innovation (creativity) successfully. Identify any use of information technology in the process. Write a short paragraph about the case. Combine the information from all team members and vote on which company made the best use of information technology.

Rolling Thunder Database

21. Identify the competition in the industry. Who are existing rivals? Who are potential rivals? Be sure to define the industry carefully. Consider using North American Industrial Classification System (NAICS) codes.

22. Perform a value chain analysis of the company. Could they improve profits by expanding vertically or horizontally? Are there additional products we should consider offering?

23. The management has the opportunity to purchase a chain of retail bicycle stores. Evaluate the strategic aspects of this proposed acquisition. What will be the effect on the information systems? Can the existing information system be used to improve the operations of the retail stores? What additions and improvements would be needed?
24. How can the company use social networks to increase ties to customers?
25. Examine the value chain in the bicycle industry. How many levels are there and which levels are the most profitable?
26. A key element in the bicycle industry is that sales are driven by the popularity of the sport, which in turn is influenced by demographics. Consequently, sales can decline over time or suddenly expand for particular bicycle models. How can a manufacturer like Rolling Thunder Bicycles strategically deal with these issues?
27. Use Porter's Five Forces model to examine Rolling Thunder Bicycles relationships and long-term strategic potential.

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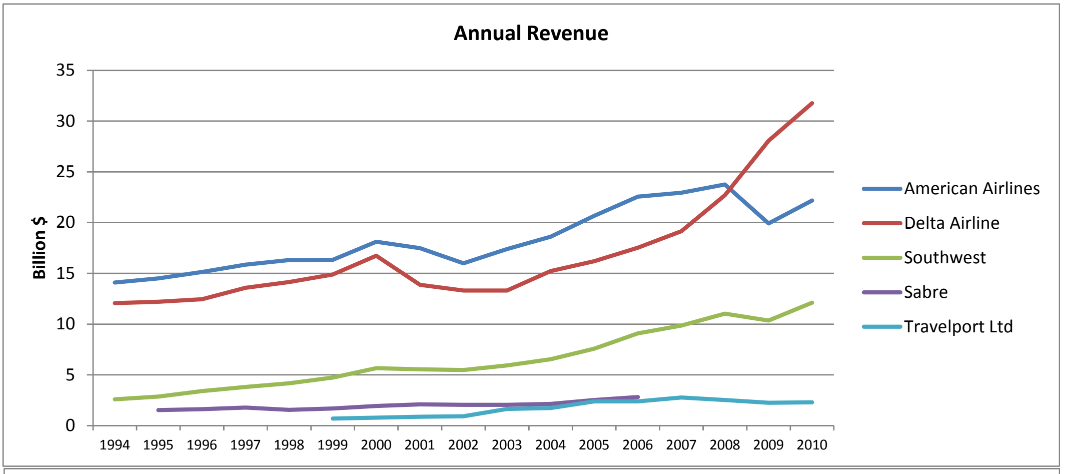
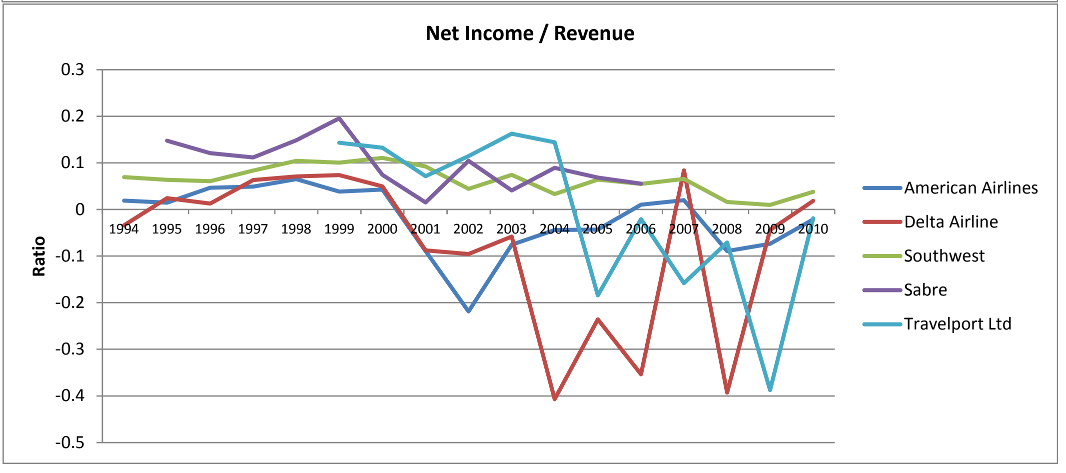
Cases: The Airline Industry

The Industry





To understand the state of the airline industry, you have to look at some of the history. The most important historical issue is that the airline industry was heavily regulated until 1978. Until then, the civil aeronautics board (CAB) controlled all of the business aspects of the airlines, including landing rights and fares. Several large airlines were established and grew during that time. In 1978, the CAB was disbanded and the airlines were free to select routes and set prices as they chose, without government oversight. However, the FAA still controls several safety issues, including work rules for flight crews, the number and spacing of flights into airports, and national flight lanes, as well as several other details.

So, what happened when flights were deregulated? This is a good time for you to start thinking like an airline executive. Were you making money? Did your passenger mix suddenly change? Are your revenue and costs any different initially? The simple answer is that initially, very little changed. As an established company, with procedures and a system that works and makes money, you would not be inclined to change anything.

Deregulation and Competition

But, all it took was a little time. A few airlines started offering new flights on high-demand routes. Then, Donald Burr founded People Express, the airline that scared every other business manager, starting in 1981. As a no-frills airline (it charged $3 to check luggage and sold snacks on the plane), the airline charged incredibly low prices to fly tourists. You no longer had to be in the upper class or funded by a business to fly. Based out of the unused international terminal in Newark, New Jersey, the company picked up non-union crews, negotiated with the FAA to fly with only a pilot and copilot (no flight engineer), and charged fares of a paltry $59 to Chicago or $99 to London—a tiny fraction of the fares charged by the traditional airlines.

With their substantially higher cost structures, the mainstream airlines could not compete. So, why did People Express disappear and some of the other airlines survive? Part of the answer is mismanagement—People Express tried to grow too rapidly and did not have a solid management structure in place to handle the problems. But, a big part of the answer is that American Airlines fought back with information technology. The company quickly realized that People Express appealed to tourists who were very price sensitive. Business people stayed away from the discounter and wanted the amenities and reliable service provided by the mainstream airlines. So, American Airlines turned to its reservation system (Sabre) and estimated the number of people on every flight who were business people. It then came up with the differential pricing system (yield management) that is still in use today. Business people, those who book a couple of days before the flight and do not want to stay Saturday night, get charged thousands of dollars. Tourists, who book early, are offered low fares that compete with the discounters. The basic premise is that the large airlines want to charge higher prices and fly business people, but there is no point in flying empty seats, so they discount the seats until they are all sold. Today, it is likely that almost every passenger on a flight has paid a different price (McCartney 2003).

Growth of the Discounters

People Express did not have the information systems and could not compete. The big airlines had won—but only for a while. They did learn to adopt the hub-and-spoke system pioneered by People Express. Small feeder flights brought passengers to a few major airports, where passengers made connections to the next hub. The cost advantage of the hubs is that at the end of the day, all the planes and flight crews returned to a hub city. Consequently, maintenance facilities are centralized into a few key airports instead of scattered around the country. Plus, the key airports handle multiple flights each day, simplifying routing decisions.

But, the story is not over. Southwest Airlines was also an upstart—beginning in Texas in 1971. By flying within the state, the airline was not subject to CAB regulations. Founded and largely run by Herbert D. Kelleher, the airline grew slowly to maintain control. Part of the simplicity lay in its fee structure—far simpler than the major airlines, Southwest prices flights so that they are profitable. By supporting several daily flights to each destination, with reasonable fares, Southwest promotes itself as the "company plane." By holding down costs (flight attendants often help clean the airplane, and the company flies only Boeing 737s to minimize maintenance costs), the company grew steadily. More important, Southwest Airlines has been profitable every single year for over 30 years—a statement that no other airline can match (www.southwest.com).

Recent Changes

To understand the current state of the airline industry, you also have to look at September 11, 2001. The event shocked the American people. The industry and government response provided almost as much of a shock to the industry. Suddenly, flying became considerably more complicated—passengers and airlines wrestled with long security lines and new rules. The U.S. government bailed out most of the airlines by providing billions of dollars in grants and loan guarantees.

Yet the major airlines were still saddled with strict working rules and high wages through negotiated contracts. In December 2002, United Airlines filed for reorganization under Chapter 11 of the bankruptcy code. In 2004, the company was still struggling to obtain financing to emerge from bankruptcy (www.pd-ual.com). On September 15, 2005 both Delta and Northwest filed for bankruptcy protection. A large reason for filing for bankruptcy appeared to be a negotiation strategy aimed at reducing labor contract costs. The airlines also declared their pension plans bankrupt and foisted them onto the federal pension insurance program, removing the liability and reducing the payouts to retired pilots and employees.

Several other airlines were created in the early 2000s to pick up passengers on highly traveled routes. JetBlue, founded in 2003, is one of the largest. JetBlue is based out of JFK airport in New York City and initially focused on East Coast destinations. It has expanded to cross-country flights and is slowly adding some Western cities to its routes. It has been successful (passengers like the DirectTV broadcasts available on the seat-back sets) and profitable (www.jetblue.com). Airtran, a successful start-up from 1998, has been hammering Delta's fares in the Atlanta airport—Delta's home base (www.airtran.com). While still only carrying a fraction of the passengers of the big airlines (maybe 10 percent), JetBlue and AirTran have been growing (*The Wall Street Journal* 2002). The secret to success, as explained by Joe Leonard, the CEO of AirTran, to a congressional committee "is not to be a low-fare airline, but to be a highly efficient airline, whether you are a big airline or small, and to adapt to the changing marketplace" (Leonard 2004). In 2011, Southwest purchased AirTran.

The obvious question at this point is that since Southwest has been so successful with its strategy, why don't the airlines simply copy their formula? Yes, 9/11 and the resulting gasoline price increases due to the war with Iraq have put added pressure on the airlines. But, the big airlines were struggling even before these events. The answer is that it might not be possible for the big airlines to make the huge changes needed. Delta and United started some experiments. Delta created a subsidiary called Song in 2003 designed to compete directly with the discounters—focusing on leisure travel between high-demand cities (www.flysong.com). United formed Ted (a part of Uni*ted*) in early 2004 for the same purpose (www.flyted.com). Although the fare rules for Song and Ted are usually simpler than for the parent company, the interesting part is that it is sometimes cheaper to fly the parent airline. In 2004, the CEO of Delta, Leo Mullins, resigned, and the interim CEO suspended any expansion of the Song airline. And the Ted airline was subsumed back into United.

Airline Costs

If airlines are going to cut costs, it helps to know where those costs are. The Air Transport Association (ATA) tracks these costs and releases summary data. The easiest way to understand the costs is to examine them as a percentage of the total. By far, labor costs are the largest share (38.4 percent). All other costs, mostly administrative overhead, are second (23.7 percent). Fuel costs vary over time, but most airlines use futures markets to hedge their costs (11.6 percent). The cost of the planes seems reasonable (10.2 percent), but you also have to add in the interest costs of the debt for the planes. Since interest rates were at historical lows in 2003, the cost was relatively small (3.0 percent). Maintenance material (2.5 percent) is usually steady, unless an airline is running a large percentage of older planes. Passenger food costs have been declining as airlines drop their food programs (2.3 percent). Airlines still pay some commissions to travel agents, but that number is dropping steadily (2.2 percent). Airlines have to pay landing fees to airports to use their gates (2.1 percent). Insurance costs (1.5 percent), communication (1.5 percent), and advertising (1.0 percent) are all relatively small components (McCartney 2002). These industry averages conceal the differences between the airlines. Through cheaper labor contracts, newer planes that need less maintenance and use less fuel, and a focus on costs, the discount airlines average a cost of 7.3 cents per mile, compared with 11.7 cents for traditional airlines (Rosato 2004).

The Possible Future

A large part of the differences with Song and Ted are the union contracts. The major airlines and the flight crews need to find some way to negotiate contracts that enable the carriers to compete with the discounters. The airlines also need to find a way to reduce costs and provide a service that people are willing to pay for. The good news for passengers is that airlines should be more willing to try innovations and search for ways to provide better service.

For business travelers, some new options are on the near horizon. Several companies are building small, "personal" jets that will cost less than $1 million. Some companies will purchase the jets for company use, but the annual upkeep and crew costs still make them expensive. On the other hand, they might enable a type of air taxi service to be created. Flying from small regional airports, the jets could offer quick service directly from one city to another, bypassing the big airline hubs and their driving, parking, and security hassles. This service will probably be too expensive for leisure travelers, but would appeal to a business person who is currently being charged $2,000 for a major airline flight. That would leave the big airlines running a type of low-cost mass-transit bus service (McCartney 2003). The micro-jet option never emerged as a major player. The technology still exists, but high fuel costs probably make it too expensive to fly a small number of passengers.

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Case: Delta Air Lines

Delta (ticker: DAL) is one of the original airlines—tracing its history back to its first passenger flight in 1929. The company, headquartered in Atlanta, had revenues of $13 billion in 2003—a steady decline from 2000. With over 60,000 employees, the company flew about 100 million passengers in 2003. The company, and its code-share partners, fly to almost 500 cities in 86 nations (www.delta.com). Delta's books showed a net profit in 2000, but the company has been in the red since that time. Delta has reported a total loss of $3.7 billion in 2001, 2002, and 2003. For most quarters, the company is losing money even on operations (annual report). Fred Reid, president of Delta knows the problems: "There's no question whatsoever in Delta's mind that we are in the midst of a profound, fundamental and truly irreversible series of changes in which the value proposition to the investors and the customers is changed unalterably. In this new world some airlines are winning and some airlines are losing, and I would say that Delta is still positioning for long-term success" (Bond March 2004).

In April 2007, Delta emerged after spending 19 months in bankruptcy. The airline reduced capacity by about 10 percent and 20 percent fewer employees, as well as reduced operating expenses by about $3 billion a year. The rest of the industry also reduced flights so Delta was flying at 84 percent capacity on average flights compared to 72 percent when it filed bankruptcy. Fares also edged up, improving revenues (Isidore 2007). The airline also started expanding into international markets—assuming there was less competition on international routes, enabling it to charge higher prices. The company still lost $6.2 billion on operations in 2006 (2006 Annual Report).

Pilots and Costs

As of 2004, Delta's pilots were the highest paid in the industry. After acrimonious negotiations, then-CEO Leo Mullins granted the union huge pay raises. In 2004, Leo Mullins was removed as CEO. Given the bankruptcies at the other airlines, Delta then attempted to renegotiate all salaries. The company executives have discussed the possibility of filing bankruptcy to force the union to negotiate lower salaries (Bond May 2004). Many of Delta's older pilots are abandoning ship before it sinks. In mid-2004, 288 pilots applied for retirement, 266 of them were for early retirement. An additional 300 had already applied for retirement in September 2003. Despite the retirements, Delta has plenty of pilots available: 8400 on active duty, plus 1,060 on furlough (*Aviation Week & Space Technology* June 2004). Delta's total costs of flying domestically are 30 percent higher than Southwest's (McCartney October 2002).

Subsidiaries

To fight the discount airlines, Delta established or purchased several subsidiary airlines. Delta Express and Skywest are two regional subsidiaries that operate out of Delta hubs. These airlines fly smaller planes or regional jets and deliver passengers to the hub, providing access to Delta in smaller cities. A key arrangement with the pilot's union allows the regional airline pilots to be paid less and fly under less limiting rules—as long as the planes carry a limited number of passengers.

In 2003, Delta launched service on Song. Although the goal was to keep fares relatively low, Song was competing more with JetBlue than with Southwest. In particular, the airline offered seat-back television for satellite programs, pay-per-view movies, and video games. However, the company had trouble getting the systems installed and had to begin operations without the technology for several months. Another drawback faced by Song was that they used the same Delta personnel, with the same contracts and lack of focus on cost cutting (Melymuka 2003). When Leo Mullins was replaced by Gerald Grinstein as CEO in 2004, Grinstein halted expansion of the Song division.

In 2008, Delta bought Northwest Airlines and merged the two companies (Crawley 2008). It took several years to merge the names and information systems of the two companies.

Information Technology

Information technology has an impressive role in the history of airlines. At the pure transaction level, IT is necessary to handle the millions of reservations a day. Running from huge databases, the large systems find flights, check seats, and bill customers when seats are reserved. When American Airlines used its system to create yield management and differentiate prices, it represented a milestone in the competitive use of technology. But today, the reservations systems have been moved out to subsidiaries and passengers can book online or through third-party reservation systems. Although the systems are still used by some of the major airlines to jockey prices, companies are increasingly looking at simpler fare structures. In 2004, Qantas, the Australian airline, decided it was pointless to run its own system. CIO Fiona Balfour, said "I don't think airlines get a competitive advantage form IT anymore. They get competitive advantage from how they use it. Running IT at a low unit cost becomes a competitive advantage" (Kontzer 2004). Nonetheless, Delta (and most of the other major airlines) continues to run its own systems. Delta's CIO, Curtis Robb, believes that outsourcing will not necessarily reduce costs or improve service. He observes that "we get payback on a yearly basis for in-house IT work and we get it at a fraction of the cost" (McDougall 2003). Note that the in-house reservation systems are separate from the aggregators including Sabre and Orbitz.

Away from the reservation system, Delta is working harder to use the transactions to increase the operational efficiency. For example, the company runs the Delta Nervous System (DNS) that pushes data from the transaction system out to the desktop and even handheld computers. For example, as a plane arrives at an airport, the gate agent and luggage handler are notified electronically. A first step in creating the DNS was to set common definitions for data stored in over 70 different databases and place every item into one of 15 subject categories. This system forms the foundation of all the real-time applications. For example, the gate information display simply queries the DNS data layer for real-time information about the specific flight, formats it, and presents it to the customers. New applications can be built relatively quickly—programmers need only identify the data they require and can focus on the application and display. At Delta hubs, the DNS data is supplemented with data from the federal air traffic control (ATC) system. This data is examined for late flights and enables managers to spot problems and reschedule flights. DNS is a $1.8 billion project started in 1998 (*Air Transport World* 2004.

The company also installed customer relationship management software for the call center. The CRM system enables clerks to see the entire picture of the customer who called (McDougall 2003). In the process, the company consolidated 30 customer databases into one, with three data warehouses to support analytical functions (Gareiss 2003). The newer jets offer additional ways to save money through integrating with information technology. The Boeing 777 collects information from various subsystems electronically. This telemetry is collected and transmitted to the maintenance engineers. If a problem arises, such as excessive vibration in an engine, managers can spot the problem and correct it before it causes additional problems. The company is also working to create electronic documents for all of the maintenance procedures. Electronic versions can be provided instantly to maintenance workers—saving search time (McDougall 2003b).

Like other airlines, Delta has installed kiosks to encourage departing passengers to record their own check-in, saving money by reducing the number of ticketing agents. Delta has also created a telephone system that customers can use to check in. More importantly, the IT system automatically monitors late flights and missed connections. If a passenger is not going to make a connection, the system automatically rebooks the flight (Schwartz 2004).

In 2006, Delta launched a three-year project to update its primary systems with a service-oriented architecture (SOA). One goal was to replace BEA System's Tuxedo middleware with standards-based technology. Middleware takes data from one system and converts it into a format that can be used by other systems. By standardizing the data interchange, it will be easier to replace various systems in the future (Havenstein 2006).

Delta was able to use the bankruptcy filing as a lever to renegotiate contracts, including a 27 percent drop in software fees from \$3.74 million to 2.73 million charged by SAP. Delta uses SAP software for ordering supplies and tracking spare parts (McDougall 2006a)

Bankruptcy is not a panacea—it can cause more problems than it solves. In October 2005, Delta's pricing system crashed for 12 hours, costing the company more than \$4 million in revenue. IT outages also led to several flight delays. Delta reported that it experienced "unprecedented attrition" and chaos within the IT department as workers left in droves following the bankruptcy filing—only 39 percent offered a job decided to stay. In August 2006, Delta outsourced its operations to IBM under a seven-year contract (McDougall 2006b). With a shortage of workers, Delta turned to other providers to help with systems, but bankruptcy made it more difficult to pay the bills. Unisys asked the bankruptcy court to pay it \$37,000 for developing an application to assign a unique product code to the special handling required for transporting human remains. According to the work order, Delta's system did not distinguish between human remains and other priority shipments, leading to "service failures and irate customers" (McDougall January 2007). Cisco also had to file a claim to get paid for \$20 million in leased equipment (McDougall March 2007). If you were a CIO at a major corporation, you would probably see similar claims and have to deal with these standard issues. The interesting aspect of bankruptcy filings is that the information becomes public.

On a more personal level of technology, airlines have been adding Wi-Fi service to the flights so that passengers can surf the Web aboard planes. The airlines purchase the service from a third-party such as GoGo (Lawson 2011).

Questions

1. Why do people fly on the discount airlines? What do they not like about the discounters? Can Delta combine these answers with IT to regain market share and profits?

2. How does Delta use technology to reduce costs? Is it enough to make a difference?
3. Can Delta use IT to become more like Southwest? Is that the best strategy?

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Case: Southwest Airlines

One of Herb Kelleher's favorite stories is that back when they started flying to West Texas, the competitors tried to fight back by matching his fares. Herb's answer was to start offering a bottle of whiskey to every Southwest passenger. Within a few weeks, Southwest (ticker: LUV) became the largest liquor distributor in West Texas. Knowing the customers and not being afraid to take chances (or play jokes) became hallmarks at Southwest. At one point in 2002, domestic traffic at the nation's five largest airlines fell by 10 percent. At the same time, travel on the five biggest discount airlines increased by 11 percent. In 2002, the discounters accounted for 20 percent of U.S. passenger traffic (Trottman 2002). Within California, Southwest flew a whopping 63 percent of the passengers (Leonhardt and Maynard 2002).

To traditional airline executives, the amazing aspect of this change is that even businesspeople are flying on the discount airlines. Southwest pushed this concept hard for many years—emphasizing that a manager could get on the plane at the spur of the moment and fly to a business meeting at a reasonable fare. One executive, Brent Harris, managing director of Pacific Investment Management, notes that he now flies JetBlue for business instead of one of the big carriers for transcontinental flights. He observes that "While I could afford to pay more, there's a certain sense of satisfaction," in getting the discounts (Trottman 2002). Southwest began adding transcontinental flights (from Baltimore) in 2002 (*The Wall Street Journal* 2002).

Southwest is an incredibly efficient airline, turning a plane around in as little as 20 minutes. Other airlines average 50 minutes. As a result, Southwest is able to fly its Boeing 737s an average of nine hours a day, compared with six hours for Delta and United (Trottman 2002). In general, the major airlines would have to cut 29 percent of their costs ($18.6 billion) to match the cost structure of Southwest (McCartney 2002). In 2002, Southwest had become the nation's sixth largest airline.

Not all is rosy in the Southwest family. In 2004, Herb Kelleher had to step in to negotiate a new contact with the flight attendant's union. Normally, negotiations are friendly at the employee-centered company, but these took two years to settle. In the end, the workers gained an average 31 percent raise spread over six years (*The Wall Street Journal* 2004). In July, James F. Parker resigned as CEO.

In 2005, Southwest CEO Gary Kelly commented on the changing competition in the airline industry, "I think all carriers are low-fare carriers. To survive, all carriers are going to have to be at least lower-cost carriers." In this new strategic environment, Southwest still wants to be the low-fare airline, and Mr. Kelly wants to use technology to reduce costs. One step was to shift more reservations onto the Web site, where costs run $0.50 to $1 versus $10 or more for other methods. By focusing on airport operations, including customer service, the airline has been able to reduce costs by hiring fewer employees. In 2000, the airline employed 95 people per aircraft owned. By 2005, the number was down to 73 or 74 (Steinert-Threlkeld 2005).

In 2007, Southwest announced that it would slow its expansion, including a reduction in the number of new planes it will add. The airline also reduced some roundtrip flights in underperforming markets. The company was also planning to announce a new boarding/seating method at the end of 2007 (press release June 27, 2007). Ultimately, Southwest continues to expand. In 2011, Southwest took a big step by purchasing AirTran. The company expects the merger process to take a year, but AirTran dramatically expands Southwest's reach on the East coast (press release May 2, 2011).

One major change for Southwest was the increasing costs of fuel. According to the 2010 Annual Report, in 2005, when fuel was $1.13 a gallon, fuel costs were 21.4 percent of operating expenses. In 2010 at $2.51 a gallon, they were 32.6 percent of operating expenses. Industry-wide, the market crash of 2008 and 2009 also resulted in a drop in demand for flights, so all airlines struggled during the recession.

Information Technology

Even in the early days, Southwest managed to avoid many of the hassles of reservation systems. For years, the company was able to list its flights for free on the industry reservation systems. It required travel agents to call the company to book the flight—the systems carried listings for free but charged when flights were booked. One estimate places the cost of booking through the Sabre system at $12 to $14 per transaction (Hoffman 2002). Today, Southwest has benefited considerably from the Internet. Customers can see all fares quickly and make their own reservations. Southwest gets over 40 percent of its bookings online, compared wit United's 5 percent (Trottman 2002). The Internet also makes air fares more transparent. Even businesspeople can quickly see the difference in the prices across airlines. Using the online tools, travelers can arrange flights to avoid the huge fares that airlines are trying to hoist onto business fliers. David Weiner, corporate travel manager for DaimlerChrysler, explains that although the company has preferred discounts with Northwest, most of his managers would rather fly Southwest. He claims that "with companies like Southwest, their fares are affordable as is. It's not like you would require any additional discounts" (Leonhardt and Maynard 2002).

Southwest also pioneered business reservations on its Web site (www.swabiz.com). In addition to letting managers and workers book flights, the system tracks companywide data for travel managers. Kaiser Permanente, a major health care organization, spends $6 million on Southwest travel. The business site enables Margy Skinner, the travel manager, to identify all tickets and use them to obtain quarterly bulk rebates (Kontzer 2004).

The Web site is so critical to Southwest that it rebuilt the system in 2002. The new UNIX-based system uses servers from Fujitsu in a cluster to ensure that the system keeps running and can scale up. Steve Taylor, director of interactive marketing observes that "the bedrock of customer service in the online world is always being there. That's what we're aiming for with this clustering project" (Greenemeier 2002). The online marketing team consists of 70 employees, with 50 of them IT professionals and the rest marketing specialists.

Southwest does use information technology to help analyze its data. Since it does collect a large share of the transaction data directly, it has purchased business intelligence tools to help analyze it. In particular, the company is using Hyperion's Essbase OLAP application and budgeting software to make financial forecasts. Mike Van de Ven, vice president of financial planning and analysis at Southwest notes that after the September 11 attacks, the company knew it faced huge uncertainty and needed help. He adds that "we were asked to give some sort of financial insight for a variety of decisions the company might make" (Songini 2002). Before installing the $1 million software, managers relied on writing custom database queries and evaluating the data in spreadsheets. Essbase provides immediate analysis and charts, cutting analysis time to as little as two minutes. Managers use the system to evaluate best and worst case scenarios to determine how to respond to problems. The software paid for itself within the first year by providing more accurate forecasts and saving time for managers.

Unlike the other big airlines, Southwest is growing—that means it needs to hire more workers. Growth is good for both the company and the employees, but how can Southwest deal with the 200,000 resumes a year that it receives? Southwest is turning to Deploy software to handle the major tasks of hiring. The software tracks everything from job requests by departments, to application progress, and candidate matching and ranking. The tool also integrates with the U.S. government system for verifying job candidate fingerprints and validating drug-test results (Hayes 2003).

Radio systems in airlines are ancient. Even if the planes and radios are new, they use technology developed in World War II. As one of the few airlines making money, Southwest is one of the first to install a new digital technology (VDLM2) to transmit data between its dispatchers and aircraft captains. Because the technology is restricted to a portion of the VHF bandwidth allocated to airlines, it provides a data rate of 31.5 K bits/second. But that rate is 15 times the rate of the company's old system. The system primarily handles short text messages—often instructions on the best route around weather problems. Ultimately, the system will be used to transmit high-resolution weather radar images to the cockpit. The company is also planning to collect telemetry information on the plane's performance and route it to maintenance personnel at the next airport if problems are detected (Brewin 2004).

With high prices for fuel, airlines began focusing on methods to reduce flight distances and times. In 2007, several airlines, including Southwest, began implementing flight-planning software from Jeppesen. Jeppesen has long been known as a provider of flight maps and related technologies. In early trials, the system was able to reduce flight times on hundreds of flights from 4 to 7 minutes. A couple of minutes might not sound exciting, but do it enough times and an airline saves millions of dollars. EDS also sells flight-planning software to more than 40 airlines worldwide (Weiss 2007).

Because Southwest focuses on costs and profitability, it also tries to hold down spending on technology. Rarely is it the first adopter of a new technology—instead, it finds ways to get passengers from point A to point B as simply as possible. For instance, the flights do not assign seats and it was one of the last to print paper boarding passes. By 2005, the CEO reported that IT costs had flat-lined to about $170 million per year, for equipment and wages. The company also applies its knowledge of operations to IT development. Mr. Kelly, the CEO noted that "we have a single data architecture. We have a standard testing approach, where we will rarely allow shortcuts" (Steinert-Threlkeld 2005).

In 2010, Southwest announced plans to implement a new reservations system (2010 Annual Report). The main goal was to be able to handle international flights, either with Southwest planes, or with a code share arrangement through another airline. Prior to this point, Southwest focused only on domestic flights and the reservation system was designed only for those flights. Yet, as Southwest grows, it feels it needs to be able to compete with the larger airlines who continually emphasize their international reach. In 2011, Southwest altered its frequent flyer program to be based on a point system instead of the number of trips. The points are based on dollar value of the tickets, presumably to reward business travelers who pay more money for flights than tourists. The new program required a complete rewrite of the software and Web site to support the changes.

In 2010, Southwest finished integrating the SAP ERP system which replaced the old general ledger, accounts payable, accounts receivable, payroll, benefits, cash management, and fixed asset management systems (2010 Annual Report). The new systems are integrated, providing managers with a comprehensive view of the accounting data.

Questions

1. How does Southwest use information technology to establish fares?
2. How has Southwest used the Internet to gain at least a short-term competitive advantage?
3. Can Southwest maintain its competitive strengths as it continues to grow? What risks will the company face?

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Case: Sabre

Sabre (ticker: TSG) is the monster real-time reservation system originally created by American Airlines. The first system went live in 1960 and handled 84,000 telephone calls a day. In 1964, the system ran on its own private network—reducing American Airline's staff by 30 percent in the first year. In 1976, the system was installed into travel agent offices—quickly reaching 130 locations. In 1985, preceding the Internet adoption by several years, easySabre gave dial-up access to users with personal computers. In 2000, the company was spun off as a separate entity, but tracking-stock data is available back to 1996. In 2004, the system handled $70 billion of travel products and connected 53,000 travel agents. It also forms the foundation of the Travelocity Web site (www.sabretravelnetwork.com).

Technology

For years, the Sabre system ran on large IBM computers. Much of it was jointly developed with IBM, since the demands and technologies needed continually pushed the available hardware and software. The system handles 15,000 transactions per second and tracks 79 million air fares. In 2001, the company announced it would migrate the massive system to a completely new architecture—based on a UNIX platform (Anthes May 2004), but the transfer would take several years.

Throughout its history, Sabre has been a leading-edge system, handling huge transaction volumes and providing detailed data for analysis. Almost all of the code has been custom written. In 2000, Sabre produced Release 8 of its AirFlite Profit Manager. The modeling and forecasting package is used by airlines to estimate demand for seats on every flight. It is the core of the yield management system. Release 8 had about 500,000 lines of code. The problem is that it was four months late because final system testing turned up 300 bugs. The first customer found 26 more bugs in the first three days, and additional joint testing turned up another 200 defects. Sabre and its development team were embarrassed. However, the situation mirrored other development projects. The catch is that Sabre has 62 software products with 13 million lines of code. It cannot afford defect rates that high. For Release 10, shipped in December 2002, Sabre turned to extreme programming (XP). With XP, programmers work in pairs, but more important, they define testing procedures for each module before writing the code. The final version turned up only 100 defects after 16 months of use. At the same time, programmer productivity increased. The reduced defect rate also cut the number of support programmers needed (Anthes March 2004).

Partly from the increased competition, partly from the need to support new standards, Sabre moved in 2005 to replace its 15-year-old EDI system with Web services applications. Web services uses standards such as HTTP and XML to exchange data more easily with remote systems. The standards reduce the cost and the use of the Internet reduces the transmission costs and make it easier to develop applications that work together. Transferring data from airline systems onto Sabre's system and ensuring timeliness and accuracy represent substantial costs for airlines (Havenstein 205).

Competition

Despite the technological advances and prowess of Sabre, it faces competition. Its biggest competition is undoubtedly the Internet. Although the company runs Travelocity, one of the big Internet travel sites, the site is not profitable yet. Furthermore, when customers book flights through Travelocity, the airline or hotel pays a fee to Sabre. Consequently, airlines have been encouraging customers to book their flights directly at the airline Web sites—bypassing Sabre entirely. The Orbitz Web site was created by the five largest airlines specifically for that purpose. It searches the company's individual databases and routes the customer's choice directly to the airline's server.

In 2004, Alaska Airlines, tired of waiting for new services from Sabre, decided to create its own itinerary-planning and fare-searching system on a Linux-based system. Alaska simply purchased the system from Cambridge, Massachusetts ITA software. Steve Javris, vice president of e-commerce at Alaska, noted that "we couldn't wait on Sabre. ITA's algorithms are widely regarded as the best in the industry" (Verton 2004). Alaska will continue to use Sabre to book reservations, but will use the new system for data analysis. The ITA system is primarily used as the back-end processor for Web sites—helping customers identify routes. Jeremy Wertheimer, ITA's founder and CEO, comments that "it processes and confirms availability for [trip] pricing in less than one-tenth of a second" (Verton 2004).

But, Sabre is not standing still. The company is creating new tools to encourage airlines to continue using the system, and new products that will help travel agents. In terms of helping the airlines, Sabre launched its interline e-ticketing (IET) hub in 2004. Since Sabre serves multiple airlines, it is in an ideal position to provide links between them. Previously, customers had trouble booking e-tickets for flights that involved multiple airlines. Each system was separate and the airlines had to reidentify the passenger at each step. With the interline system, the passenger data and validation are shared across airlines. Essentially, Sabre serves as an EDI consolidator and translates data from each system into a common format that is accessible to all systems. The system is based on Web services, making it easy to expand and change as airline systems change (Rosencrance 2004).

Sabre also introduced a new feature for travel agents in 2004. What happens if a customer wants an aisle seat, but the only seat available is a middle seat? A good travel agent would book the available seat to keep it, and then periodically check the flight to see if a more desirable seat opens up. But that requires considerable time and effort by the travel agent. Sabre's answer was to create an event model that will alert the travel agent when a seat opens up. Loren Brown, CIO of Carlson Wagonlit Travel, a company with 8,000 agents, notes that agencies would likely pay extra for that feature alone, stating "that would be a much more elegant solution than we have in place now" (Kontzer June 2004).

Sabre also faces competition from more traditional rivals: Amadeus Global Travel Distribution, Cendant's Galileo International, and Worldspan. All of these were originally developed by other airlines and spun off as well. All of them are facing similar problems and working to cut costs and offer new services. That is one of the main reasons driving the switch in servers. Sabre estimates that by running the open-source MySQL database on open-source Linux servers, the new system will cost 80 percent less to operate (Kontzer June 2004).

Several startups offer new ways to search for flights, hotels, and cars. In 2006, ITA Software received $100 million in venture capital funding. Its system drops processing costs to a couple of dollars a ticket, compared to the $12 a ticket that airlines pay to Sabre for each reservation. ITA CEO Jeremy Wertheimer observed that "almost every ticket you buy is still being handled by assembler code running on a mainframe." His systems use inexpensive x86 PC hardware running open source software (Kontzer 2006). Many airlines pass that cost onto customers, so savvy customers use the search systems (such as Sabre's Travelocity) to locate the lowest-cost flights, and then book the flight directly with the airline—so Sabre gets paid only for the listing, not for the purchase.

Low-cost airlines have been particularly reluctant to book flights with Sabre. Southwest relied on its own system and Jet Blue dropped the Sabre listings when more customers began booking directly with the airline. AirTran bucked the trend in 2005 when it added all of its flights to the Sabre system (Kontzer 2005). By 2007, facing increased competition for low-fare flights, Southwest added its listings to Sabre and to the Galileo search system (Wall Street Journal 2007).

Experts have questioned how long the big reservation systems will compete with the startups. In 2005, Sabre took one step by purchasing European company Lastminute.com for slightly over $1 billion. The site primarily gives Sabre access to the European market (Information Week 2005). Competitor Expedia had already purchased Hotels.com and Hotwire.com. Orbitz owns the Web site CheapTickets.

In 2008, Sabre added a social network component to its system (Havenstein 2008). The objective was to enable people to share advice and recommendations about their travel plans. It is not clear if anyone uses the system—particularly since anyone could use existing social networks instead.

The Future

With so many competitive factors, it is difficult to guess who is going to win the battles for customer reservations. Sabre and its direct rivals have some amazing technology as well as the developers to build complex systems. One of the things that might be changing is that passengers will want to book package deals. But not quite like the old "here's a tour—take it or leave it." Instead, customers will want to go to a site and select their own custom bundle: pick low-cost air fares, choose hotels that offer the desired amenities at an acceptable price, then add in some adventure excursions. Yes, the big travel sites support these steps in a limited way now. However, they rarely allow anything more than limited customization. Ultimately, customers want a more intelligent system that can create desired bundles—at a discount. So, airlines, hotels, and other providers will need to cooperate. Then, the reservation sites will have to become sophisticated enough to balance the various choices and compute all of the package deals (Kontzer May 2004).

Sabre Holdings Corp. was purchased by private equity firms in March 2007 for $4.5 billion, so it is no longer a public company (Fox News 2006). Operations are likely to continue as before. Private-equity firms went on buying sprees in 2006 and 2007, searching for companies with relatively low stock prices, that the investors believed could be used to generate solid cash flows.

In 2010 and 2011, the reservation industry faced several major challenges. First, the recession affected bookings so revenue was down. More importantly, the airlines began rebelling against the fees charged by the big sites (e.g., Travelocity and Orbitz). American Airlines went so far as to remove its listings from all of the major sites. Which was interesting because Travelocity (Sabre) was once a division of American Airlines. The goal at AA was to encourage customers to book flights directly at the company's Web site, bypassing the fees charged by the ticketing sites. Southwest uses this technique to save money and AA managers wanted to do the same thing. Eventually, AA renegotiated with most of the systems, but passengers are well-advised to double check fares on individual airlines to get the best prices. Some sites, notably Kayak, automatically check fares through the big travel sites as well as the individual airlines.

Another interesting issue arose in 2010 when Google proposed to buy ITA Software (Perez 2010). ITA is a company that provides the airline data to many of the other travel sites, airlines, and Microsoft Bing. The company was founded in 1996 and has about 500 employees. Google wants to own the company so that it can integrate flight data and reservations directly into the Google search engine. But, other providers worry that this step would reduce competition, meaning take away their customers. Eventually, the Department of Justice approved the purchase but imposed a few conditions to encourage continued competition.

Despite the advances, travel search engines are still somewhat primitive. For starters, they rarely find the best prices. But, remember it is the airlines that pay the initial fees, so they have an incentive to arrange the systems to support their objectives. The flexible searches that check multiple departure dates and different airports do help users find better prices, but in the end, a human has to do a large amount of work to find the best fares and flight times.

Questions

1. Who are Sabre's competitors?
2. What risks does the company face? Will travel agents continue to exist and will they use Sabre?
3. What factors are needed for an intelligent agent reservation system to be created? Who would create these elements?

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Case: American Airlines

American Airlines (ticker: AA) is one of few original airlines still in existence. The company traces its history back to mail flights by Charles Lindbergh in 1926. By February 1937, American had carried one million passengers. At the start of 1959, American was the first to offer coast-to-coast jet service with the Boeing 707. In 1959 and 1960, American teamed up with IBM to develop and implement the SABRE (Semi-Automated Business Research Environment) system for handling reservations and business data. By 1964, the SABRE network extended across the U.S., Canada, and Mexico. American was proud to be at the leading edge of aerospace and information technology (www.aa.com--history).

When the airline industry was deregulated in 1978, low-cost carriers arose across the nation—led by People Express in New Jersey. For four long years, the major carriers did not know how to compete. In 1985, American turned to the data held in the SABRE system to devise a winning strategy. Introducing Super Saver fares—for travelers who booked in advance and stayed over Saturday—American was able to compete dollar-for-dollar with the low-cost carriers. The secret was to hold back enough seats on each flight to sell at substantially higher rates for business travelers who booked at the last minute. The years of flight and passenger data held in the SABRE system enabled American to perform yield management to determine the optimum number of seats to hold back on each flight. In 1981, American Airlines started AAdvantage as the first frequent flier program. It was initially targeted to business travelers—to encourage loyalty (CNN Online 2006).

Over time, despite the various attempts by American and the other big carriers, competition changed the airline industry. The expansion of Southwest drove lower fares into new markets, which dramatically increased the number of passengers. Increasingly, American had to focus on cutting costs, and emphasizing its global access. But flights became commodities, where passengers simply want to get to their destination on time. But airlines cannot just throw in the towel and give up. In the 1980s, Bob Crandell, the CEO at American, thought about trying to become like Southwest Airlines, but realized it was not possible. Instead, the company focuses on using technology and creating systems to reduce costs and provide better service to customers (Rosencrance 2005).

In 2011, American began offering Samsung Galaxy Tab 1.0 devices to premium class passengers on its flights. The tablet is configured to provide in-flight entertainment and will allow passengers to browse the Web or check e-mail on flights with Wi-Fi installed (Hamblen 2011). Like the other carriers, American lost \$2.1 billion in 2008 and \$1.5 billion in 2009. But, unlike some of the others, American continued to suffer losses (\$0.5 billion) in 2010 (2010 Annual Report).

Technology

Sabre drove American Airlines for 40 years, handling transactions and providing information about flights and crews. But, American became dependent on the system, and it was a system designed in the 1960s. When employees have new ideas, it can be difficult or impossible to reprogram Sabre to incorporate innovations. Captain Doug Pinion, scheduling chairman for the Allied Pilots Association at American, has had several ideas for saving money. For instance, he suggested back-up pilots could use the Web to bid on flights scheduled for the next day. But pilot's suggestions are overruled as too expensive, and American selects pilots based on seniority; phoning each person in turn. The problem is that the information system is too difficult to reprogram for new tasks. American's CIO in 2003, Monte Ford, said that all of the major airlines face the same issues. "In a lot of ways we're better advantaged because of the kinds of upgrades we've completed or are about to complete" (Gage 2003). Some operations have been moved onto Unix and Windows servers—pulling data from the Sabre transaction processing system. However, Ford believes that the mainframe system is still the best way to handle millions of transactions.

In many ways, the advent of the Internet accelerated the conversion of airline seats into commodities. Customers, tourists and businesses, can quickly and easily see the prices. Some Web sites, such as farecast.com, even track patterns for flights, and others can provide immediate notifications of any price changes. Henry Harteveldt, a vice president at Forrester Research noted that "yield-management systems made it possible to have more fare types than seats on an airplane. But the airlines got greedy, and their bad pricing strategies caught up with them when the Internet exposed the pricing structures." The bottom line is that the established carriers have substantially higher operating costs than the discount carriers, as much as 7.2 cents per seat-mile (Rothfeder 2005).

Reducing costs will entail more than wringing additional concessions from labor, retiring old planes, and closing a few hubs. Even after exiting bankruptcy, Delta and United only reduced costs by small amounts. Ultimately, the big airlines like American will have to find a way to simplify operations and reduce the huge administrative costs. The micro-jets are waiting in the wings. Robert Crandall, ex-CEO of American Airlines, and Cameron Burr, son of Donald Burr, ex-CEO of People Express, have teamed up to start an executive taxi service called Pogo based on microjets (Meehan 2007). Depending on the progress of FAA certifications, operations were planned to start in 2008. For about the same price as business-class seats executives will be able to charter a flight that flies directly to the desired airport on any desired time schedule. The jets can fly into smaller, more convenient airports, and passengers will have no lines for security, check-in, or baggage. Ultimately, the jets could eat away at the passengers that yield-management relies on for profits.

American faced the same problems as every other airline during the recession. In an attempt to reduce costs, it tried to encourage passengers to book flights directly on its Web site and to send booking data directly to travel agents (2010 Annual Report). The company ran into contract-violation problems when it tried to remove its listings from the major ticketing agencies, and eventually relisted its flights on most of the systems (Cameron 2011). In 2011, American sued Orbitz and Travelport LP alleging anticompetitive practices. Overall, the company is focused on reducing costs.

Questions

1. How can American compete with Southwest?
2. Is it possible to rebuild American's information system?
3. How can American compete with the coming microjets?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 11

Entrepreneurship

Chapter Outline

What You Will Learn in This Chapter

- How can small businesses use information technology?
- How are small businesses different from larger ones?
- What information and technology do small businesses need?
- How do you start a business?
- How will your business be different from the existing firms?
- How do you turn an idea into money?
- Is it true that genius is 1 percent inspiration and 99 percent perspiration?
- What additional steps are required to start and EC firm?
- Why did thousands of dot-com firms fail?
- How does cloud computing help startup firms?

Petz Enterprises, Inc.

How can small firms use the Internet to improve their business? Petz Enterprises in Tracy, California, is a family-run company that specializes in income taxes. The company became a leader in providing software to professional accounting firms and storefront tax offices. The tax-accounting staff at Petz keeps up with the hundreds of tax-code changes made by the federal and state governments. It then writes the rules that compute the taxes and print the forms. As a closely held company, Petz does not report its financial data.

With the growth of the Internet, Leroy Petz, Sr., decided that the firm had to expand and create a system that could be used directly by individuals. The initial TaxBrain site attracted several respondents in the first two years. After it was given a substantial facelift, and backed by online advertising, the site became the third most popular tax site on the Internet. TaxBrain faces some serious competition with the well-known brands of H&R Block and TurboTax (Intuit).

Entrepreneurship, the development of new firms, is an idea that floats in the minds of many businesspeople. In 2003, over 500,000 new firms were started. On the other hand, almost the same number of firms were closed in the same time period. The Small Business Administration (SBA) reports that about two-thirds of new employer firms survive at least two years. Fifty percent survive past four years (Bounds 2004).

Information technology plays an important role in many small firms—because entrepreneurs need higher productivity. The Internet in some ways makes it easier to start or expand a business. In other ways, it increases the marketing and technical costs. And the Internet is certainly no guarantee of profits or success.

Introduction

How can small businesses use information technology? In many ways, this question has already been answered in the other chapters. You can apply the same analyses and tools to any size business. However, small businesses often face a shortage of investment money and skilled IT workers. Business owners also do not have time to spend hours thinking about IT solutions. Yet, technology applied correctly can save business owners a considerable amount of time and money. With the relatively low cost and tremendous power of information technology, it is possible to run relatively complex businesses with a small number of people.

A second major question addressed in this chapter involves starting a new business. What technologies do you need to start a business? And how can you create a company to make money online? Entrepreneurship is a growing field in the business discipline and you can probably take many courses to learn how to analyze product ideas and create a new business. This chapter reviews some of the basic concepts and shows how technology is used to make it easier and provide more information. Starting from scratch forces you to focus on the information you will need to run the business. It is a good opportunity to evaluate the technologies and data you will need to operate a business. Selling products online is relatively straightforward today. Building new Web 2.0 applications or even phone-based applications requires developing custom programs.

Estimates	2005	2009
Employer firms (nonfarm)	5,992,400	5,815,800
Employer firm births	671,800	688,395*
Employer firm terminations	544,800	592,410*
Self-employment, nonincorporated	10,500,000	9,800,000
Self-employment, incorporated	5,300,000	5,500,000
Business bankruptcies	39,201	60,837

Figure 11.1

Small business numbers. In total, small businesses in the U.S. employee about half of the total workers and constitute 99.9 percent of the number of firms. Source: www.sba.gov. *The most recent birth and termination data is from 2007.

Even if you do not intend to start or run a small business in the next year or two, you should read this chapter. First, with the number of small businesses created each year and the growth rates, there is a good chance that someday you will work for one. Second, the chapter serves as an integrated review of many of the concepts covered in the other chapters. In a small business, the manager/owner is responsible for putting everything together to solve problems and grow the firm. All of the aspects of information technology are used in this process.

What is a small business? The simple definition is any independent business that is not dominant in its industry. However, the U.S. Small Business Administration uses more specific definitions for its financial lending programs. The base definition is firms with fewer than 500 employees. In some industries, the number of employees drops to 100, in others it goes as high as 1,500. Using the 500-employee definition, the SBA concludes that about half of the employees in the U.S. work for small businesses, and 99.9 percent of businesses are small. The year 2007 saw 688,395 new employer firms created, but 592,410 were closed for a net gain of about 96,000 new firms. An employer firm is a company that has employees. It does not include single-person self-employment. Figure 11.1 shows the basic totals for 2009 (the most recent data available).

Small Business Constraints

How are small businesses different from larger ones? In many ways, all businesses have the same tasks to perform regardless of the size of the firm. On the other hand, small businesses face several constraints that can often determine whether the company succeeds or fails. The biggest issue is money—or investment capital. Partly tied to the issue of money, small businesses have smaller numbers of workers and generally lack specialists—particularly in management. Consequently, the owner, or a designated manager, handles most of the management tasks; and usually runs out of time each day. Outside the technology industry, few small businesses have any expertise with information technology. Finally, small businesses often survive by selling to one or two large companies. Looking at Porter's Five Forces model, it means that small businesses often lack strategic power. They must rely on goodwill and mandates of their largest customers. All of these constraints make it difficult for the small business to thrive and expand.

Trends

Small businesses make up about half of the U.S. economy—particularly in terms of employment. There is a high probability that you will work for a small business at some in your career. Perhaps you will even want to start your own company or become self-employed. The Census Bureau keeps statistics on the number of people employed by small businesses. The ratio of the number of small businesses to large has been relatively constant since the late 1980s. The percentage of people working for small versus large companies has changed slightly over time. In the late 1980s, about 9 million more people worked for small firms than for large ones. In the late 1990s, despite a growth in the number of people employed in businesses hiring 20-99 employees, larger firms began hiring a greater percentage of the total employees. Perhaps because of the collapsing dot-com economy, workers switched to the security of larger firms so that the share was balanced in 2001. Since that time, large and small firms have hired about equally.

However, you see more interesting results by looking at the total payrolls and the revenues of the two firm sizes. From the early 1990s, large firm annual payrolls have grown faster than small firms. In 2007, the average salary per employee was $47,400 for large firms compared to $37,300 for small firms (79 percent). It is possible that these numbers are distorted by the huge salaries paid to CEOs at large firms, but it is clear that large firm payrolls are higher. Total revenues are not reported every year, but in 2007, large firms earned an average of $302,000 per employee compared to only $190,000 for small firms (63 percent). Small firms spend a higher percentage of revenue in payroll. The lower revenue and higher salary expenses strongly affect the way small firms are managed.

Money

Small businesses by definition do not generate as much revenue as large firms and have fewer assets to borrow against. The numbers show that small firms also generate less revenue per employee than large firms do. Many have been in existence only a short time. With these factors, small businesses often have problems acquiring the money needed to expand a business, hire workers, or purchase technology. Financing options are examined in more detail in the Entrepreneurship section, but every small business has problems raising money. Eventually, businesses that are successful will generate profits that can be used to pay for items that fuel additional growth. But, except for some rare cases, this money is incremental and growth is limited to a small annual percentage.

In the meantime, businesses face ongoing expenses. Many of them are fixed costs such as leasing space, employee salaries, professional services (legal and accounting), insurance, vehicles, marketing, and information technology. Small business owners have a tendency to look at the firm's expenses as deductions from their take-home profit. Buying a new server might be nice, but at $5,000 it could represent 5-10 percent of the annual profit available to the owner. Consequently, small businesses are often reluctant (or unable) to invest in new technologies unless there is an immediate payoff in terms of reduced expenses or increased rev-

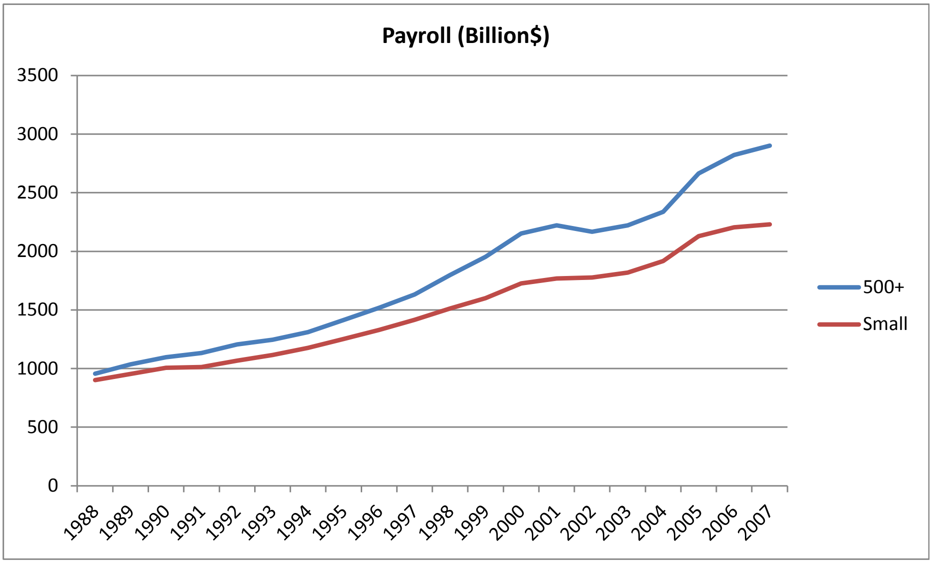


Figure 11.2

Large v. Small Payroll. Large firms have a higher total payroll. Since the number of employees is about equal, the difference arises because large firms pay higher salaries.
Source: http://www.census.gov/econ/susb/historical_data.html

enue. Figure 11.2 shows that large firms pay more on average, but small firms spend a higher percentage of revenue on employee payrolls.

Figure 11.3 shows another perspective on money by comparing small firms to large firms in terms of receipts and payroll. The base numbers consist of total receipts divided by total employees and total payroll divided by total employees. In every case, the values for the small firms are lower than those for the large firms. The table shows the value for the small firms as a percentage of those for the large firms. For example, in 2007, average receipts per employee in small firms were 62.9 percent of the value for large firms. And payroll per employee for small firms was 79.3 percent of the value for large firms.

Figure 11.3

Small v. Large receipts and payroll. The table shows the percentage of small over large firms. For example, in 2007, the average receipts per employee in small firms were 62.9 percent of those in large firms.
Source: http://www.census.gov/econ/susb/historical_data.html

Year	Receipts/Emp	Payroll/Emp
1997	64.4%	80.8%
2002	63.0%	81.6%
2007	62.9%	79.3%

Larger firms could have higher receipts per employee due to economies of scale which includes a broader base of customers and more efficient use of technology. Typically, they have also been around longer, so they have an established base of customers. Note that although small firms pay less per employee than large firms, the revenue per employee is even lower. Consequently, profitability is going to be squeezed at smaller firms.

Fortunately, with the declining costs of technology, it is easier for firms to purchase powerful tools at relatively low costs. More importantly, with the expansion of service firms, small businesses can pay monthly fees for high-end software and services. A large firm might pay hundreds of thousands or millions of dollars and hire experts to customize an ERP system. A small business cannot afford the hardware, much less the software and personnel to build an ERP and keep it running. Instead, the small business can contract with an online provider to host and run the ERP system. For a few dollars a month, the small business can obtain almost the same effectiveness. And, the system can be scaled up as the company grows—so the small business pays a small fee now but can expand the system later when revenues increase.

Workers and Specialists

In part because of the money constraints, small businesses do not hire as many workers. They will have to hire workers on the production side—factory or service workers and salespeople. But, it is expensive to hire back-office administrators or managers. Workers that do not directly generate revenue are seen as an expense. They are hired only when the owner needs additional support or specific expertise. Accounting, marketing, and production managers are the most common employees.

Small businesses rarely hire information technology specialists (outside of technology and EC firms). Workers are expected to know how to use the basic personal productivity tools. When things break, small businesses rely on service contracts or local consulting firms to solve problems. As a result, it is difficult for small businesses to keep up with technology changes or to know what tools are available to help them. They are also at the mercy of the local repair companies in terms of pricing for service and support.

On the other hand, small businesses in specific industries can often purchase the information technology they need as an off-the-shelf package. For instance, dentists, physicians, attorneys, restaurants, and so on can choose from many **turn-key systems**. The name derives from the concept that the business buys the package of hardware and software, plugs it in, turns the metaphorical key, and has everything necessary to run the business. The systems company provides support, training, and upgrades. Turn-key systems exist for a surprising number of businesses. You can often find them through advertisements in trade magazines for the specific industry. Or, you can visit similar businesses to see what they are using. The prices sometimes seem a little high, but they are often based on monthly payments—avoiding the need for large amounts of money up front.

To offset these drawbacks, small businesses should consider paying a consultant every year or two to evaluate their operations and security. Some accounting firms provide this service and some will require EDP audits to ensure basic security provisions are being met. IT consulting to evaluate technology levels, costs, and effectiveness is also available.

Figure 11.4

Lack of IT expertise. Small businesses need to hire someone to help with basic IT tasks. Operations and transactions generally work because they have to work. Tactics and strategies along with security tasks are often skipped because of the perceived cost.

Information Technology Expertise

Figure 11.4 shows that the lack of IT expertise affects more than purchasing and managing systems. As noted, day-to-day operations can be handled through purchased systems and support contracts. Often the bigger constraint is that small businesses do not know how to use IT to solve business problems—particularly in terms of searching for a competitive advantage. For example, a law firm can purchase a time-and-billing system to track paperwork and bill clients. But, the system and the attorneys know nothing about using technology for marketing or teamwork. Perhaps the firm specializes in specific complex cases. It could benefit from a teamwork system that saves all of the prior work in a knowledge management system—reducing the time it takes to prepare the next case. Such a system could be created relatively cheaply using a SharePoint server, but if there is no turn-key system for it and no in-house IT specialist, the firm might never know such a system is possible or affordable.

Computer security is another critical area of expertise that is unavailable in most small businesses. Properly installed, good turn-key systems include provisions for security. Most use passwords to grant permissions, and most have semi-automated backup systems to make it easy for businesses to maintain regular backups of the data. But, with a small number of employees, managers often circumvent the internal security provisions. For example, it is common to assign a single account with password for everyone to share. It simplifies creating accounts and solves

past	future
Fixed cost/paid for. Know how to use. Mostly works.	New hardware features. New business methods. Improved security.
Hardware failures. Limited features. Hard to repair.	High prices for new technology. Uncertain life, adoption rates. Difficult to follow tech industry. Harder to find support. Constant switching and costs.

Figure 11.5

Choosing technology timing. It can seem cheaper and easier to keep old technology for long periods of time but there are costs to keeping it too long. On the future side, shiny new technologies can appear to be useful but buying early is expensive and means understanding and choosing new technologies that might not survive. Without an MIS staff, it is difficult to keep up with and evaluate potentially useful new technologies.

problems if an employee calls in sick and other workers need access to the data. But, sharing accounts and passwords pretty much wipes out any security controls. The example shows that even if the system has good security provisions, users (or owners) can bypass them, leaving the system open for attack. Many aspects of computer security today derive from best practices that establish procedure for everyone to follow to ensure the security rules are followed. But few small businesses are aware of these best practices, and often find them inconvenient.

Choosing the timing and level of information technology is another challenge for small firms. Figure 11.5 shows the challenges faced by every business, but large companies have an MIS staff, money, and opportunities to experiment with new technologies. Small businesses (not directly involved in technology or EC), tend to purchase standard technology when they begin. Managers then keep the hardware and software as long as possible—because the costs are generally fixed and have already been paid. The problem is that older technology begins to die and software rarely gets upgraded. Problems often arise at the least convenient times causing problems and expenses for emergency repairs or even lost data. On the other end of the spectrum, buying leading-edge technologies presents different benefits and costs. Being the first to implement new technologies can lead to new business methods and opportunities to provide products and services not offered by competitors. But, new technologies are expensive and difficult to predict. New technologies often have multiple versions or competitors. Typically, one version will succeed and the others will disappear. It is hard to bet a company on a new technology that might or might not survive. And, continually switching between new technologies carries high costs of disruption.

Large firms have an MIS staff that follows technology news. Many have budgets for experimental projects and often obtain demonstration units from vendors.

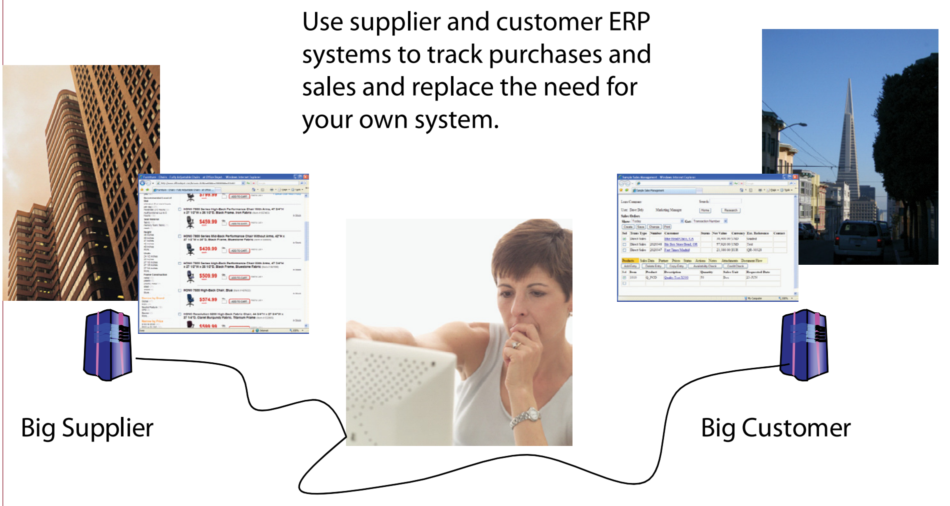


Figure 11.6

Lack of strategic power. As a small business facing 800-pound gorillas for customers and suppliers, accept their strength and use their systems. They have ERP systems that will track purchases, sales, payments, receipts and other data you need. Use their systems for detailed record keeping and consolidate the totals in a basic accounting package.

Existing small firms typically stick with older technologies. But, new small firms are probably going to buy newer hardware—although probably not leading-edge tools. Still, with half a million firms starting each year, some smaller firms will be using relatively advanced technologies.

Strategic Power

Recall Porter's Five Forces model. One method of achieving strategic gains is to build alliances with suppliers or customers. To build these linkages, you first gauge the relative power of your firm versus these external entities. But, it is pretty clear that small businesses will have minimal power in these strategic relationships. Many small businesses survive by working closely with one or two large firms. In almost any situation, the small business is going to be at the weak end of the power relationship. That means that instead of your firm initiating an alliance, you will respond to the needs or demands of the larger customer. As shown in Figure 11.6, the good news is that most large businesses already have ERP systems that provide Web-based support for suppliers and customers. You will be able to use the client's computer system to track orders, returns, and payments. The small business simply needs a Web browser and an Internet connection. The Internet connection can be simple and low cost, similar to a household link.

The drawbacks to relying on a customer (or supplier) ERP system arise when the small business grows larger and acquires more clients. Each customer will expect you to use their system for interactions. You will want a way to consolidate the data from each of the systems so you can see everything in one location. Even if the small business has its own ERP system, it can be difficult to get the systems

Operations	Accounting Sales Purchases Cash flow Production Shipping Payroll	Basic accounting software but it must use double-entry. Possibly online ERP service. Outsource payroll.
Tactics	Customer analyses Product analyses Employee evaluations Forecasting Growth Teamwork	Often skipped because of lack of expertise. Possible with spreadsheets and SharePoint.
Strategies	Smallest firm Minimal power Limited funds	Rely on larger customers and partners. Use online services.

Figure 11.7

Information tasks. Small businesses face the same decision levels but tend to concentrate on the day-to-day operations. Technology must be affordable and demonstrate a direct contribution to the bottom line. Support for tactics and strategies are often skipped or deferred.

to work together to download the data. Lacking the strategic power, the small business pays the cost to hire someone to copy data from these other systems and re-enter it into its own system. There is no good answer to this problem. In some cases, the best answer is to install the same ERP system that is used by the majority of the customers. It is easier to connect systems and share data if they are built by the same provider (such as SAP).

Buying software is another place where lack of strategic power hurts small businesses. Companies such as Microsoft give generous discounts to large companies that buy hundreds of copies of software. As a small business, you will not qualify for most of those discounts and can end up paying quite a it more money per copy than your large competitors. And, since most salespeople are paid on commission, do not expect any of them to pay much attention to you if you want information.

Information Tasks

What information and technology do small businesses need? Figure 11.7 summarizes that like any other business, a small business needs to deal with decisions and information at three levels: operations, tactics, and strategies. The information and technology requirements at each level are different, so you should examine each area separately. In most cases, you can examine the business as if it is starting from scratch. Even if a small business has been operating for a few years, it most likely needs to re-examine its information systems.

Operations and Transactions

The basic transaction tasks are sometimes the most difficult for small firms to handle properly. Large firms have many people and established rules. Small firms often record data when the managers get around to it, and procedures are perceived

Reality Bytes: IPO Fever Spreads Again

Starting in 2010 and continuing through 2011, several well-known technology companies used initial public offerings (IPOs) to make money. Many of them generated huge interest and stock prices rapidly increased on the day of the IPO. Pandora Media is one of the early companies that generated strong initial demand. The Pandora app is one of the five most-used apps on all of the major smartphone platforms in the U.S. The company has a free app and provides free access to many streamed songs. It also has a pay-model where for a small fee users get more control over the music they stream. It also gains some revenue from advertising. However, since the company was created in 2000, it has never been profitable. The problem is that as the company gains users, it streams more songs, which means it has to pay more royalties for the songs. Rick Summer, a senior analyst at Morningstar Inc., noted that Pandora faces more problems in the long run—the contract with music publishers that sets the royalty rates expires in 2015. And if listener demand remains high, the record companies are likely to renegotiate for an even greater cut of the revenue. But, investors still pumped money into the company in the early days of the IPO.

Adapted from Lynn Cowan, “Pandora Plays a Hot Tune,” *The Wall Street Journal*, June 13, 2011.

as unnecessary constraints that take too long. But without correct data, it takes longer to put reports together, to analyze the firm’s condition, and to make decisions. Many small-business owners complain about having to spend long nights searching for and collating data. Even an inexpensive accounting system—with the proper procedures—can save huge amounts of time and effort.

Most small businesses can handle day-to-day transactions through accounting systems. The standard financial data is often the most important information to the managers, and the accounting system stores everything in a database that has basic search and reporting capabilities. The key is to use at least a double-entry accounting system (as opposed to a check register), and to establish procedures so that all data is entered promptly, correctly, and verified.

Most businesses will want to hire accountants to ensure the financial data and procedures are sound and to handle annual tasks such as income taxes and state filings and permits. In these cases, the business is generally better off adopting the accounting system recommended by the accountant. The accountant will need to access the data and will be familiar with the standard operations of the software. However, small businesses should also look at the online accounting/ERP systems. The online Web-based systems are particularly useful when multiple managers need access to the data, or if there is a need to access the data while traveling. For defined monthly fees, the online systems handle the software, data backup, and basic security. The online systems offer more features than low-end standalone accounting packages and can easily expand as the company grows. Plus, the business pays a fixed monthly fee instead of paying large upfront and annual maintenance costs.

Choosing an accounting package does not automatically solve all of the transaction issues. Every accounting system has to be configured to match the specific company. The managers, perhaps with the advice of the accountants, need to

Reality Bytes: Industry Salaries

Industry	Median Pay at 5 Years	Median Pay at 15 Years
Finance/Securities	$65,200	$114,000
Federal Government	$61,500	$81,900
Hospitals	$58,900	$70,800
Information Technology	$58,300	$104,000
Manufacturing	$57,500	$89,900
Professional/Science	$57,000	$92,100
Construction	$55,600	$84,400
Transportation	$53,300	$79,000
Retail Trade	$51,300	$91,000
Management	$50,300	$76,800
Banking	$49,300	$83,900
Administrative	$48,400	$73,400
Real Estate	$46,300	$82,200
Educational	$43,000	$59,400
Arts, Entertainment, Rec.	$42,200	$67,700
Hospitality	$42,000	$68,800
Food Services	$40,200	$61,800

Adapted from Carolyn Bigda and Donna Rosato, "5 Secrets of Successful Career Changers," *Money Magazine*, May 18, 2010.

identify the information needs. Does the firm, like Rolling Thunder Bicycles, sell items by categories? Are prices fixed or negotiated on every item? For services, are they billed to customers in advance (like a cable TV bill) or at the end of the month (like a lawn service)? Who is responsible for entering data and when will each item be entered? Do entries have to be approved or monitored? Who deposits money in the bank and who records and verifies the deposits? Similar questions apply to handling purchases and receipt of supplies. All of these questions have to be identified, answered, and expressed as procedures.

Hiring employees and handling payroll is another challenging transaction task. Today, even small businesses need to verify applicant information such as taxpayer ID numbers. Tiny firms can probably get by with simple payroll systems, but you still need to handle federal, state, and local tax withholding, plus unemployment compensation and so on. With dozens of employees, you might want to offer more advanced payroll options such as health insurance, direct deposit, and retirement plans. There is no way a small business should handle these details itself. Almost all companies contract payroll services to an outside firm. Several nationwide payroll firms exist and many can handle even small firms at reasonable costs. Automated Data Processing, Inc. (ADP) is one of the oldest and largest. Providers of small-accounting packages such as Intuit also provide these services, but you should compare services and prices with several vendors.

Communication systems and networks should also be included in an analysis of operations. In the old days, you would have to set up a business account with the local telephone company and probably purchase an expensive telephone system. You can still take this route, but it is probably cheaper today to use cell phones. They have the added advantage of mobility so your employees can be reached at any location. But, like every other technology, prices change and you will have to investigate the various options to ensure you are not missing some low-cost alternative.

Internet connections are an important factor in any business today. The biggest decision to be made is whether you need full-time high-speed access lines, such as frame relay or T1 lines. Chapter 3 shows that these are relatively expensive at hundreds of dollars a month. But they are necessary if you want to run your own Internet servers. For most firms, it is going to be substantially cheaper to pay someone to host Internet servers and go with a simple DSL, cable modem, or Wi-Max Internet connection. These services provide relatively fast download speeds for a reasonable monthly fee. They are generally fast enough to be shared with several employees, but you will have to monitor performance. If your firm transfers huge files or you gain dozens of employees, you will have to increase the Internet bandwidth through additional services.

Tactics and Decisions

Few small businesses have the expertise to analyze data. Many might not even have the data or know how to get it out of their accounting systems. Yet, business survival can depend on knowing which customers are the most profitable, which products and services make the most money, or identifying regional or annual selling patterns. Fortunately, the basic tools are relatively inexpensive. Most small-businesses have a limited amount of data that can be easily handled with basic tools—often just a spreadsheet. You will find that most small businesses do not have copies of Microsoft Access. Fortunately, the Office 2007 version of Excel can handle substantially more rows than in the past. Queries are not quite as convenient or powerful, but you can use a worksheet as a small database.

Even a basic PivotTable can be used to help managers explore subtotals and search for patterns in the data. Chapter 9 shows that more complex analyses can be performed using spreadsheets, but it might be helpful to have an expert look at the business and set up the initial spreadsheets. At a minimum, an owner with limited knowledge of the statistical tools should have an expert examine and test any complex spreadsheets. Several companies have experienced major problems due to faulty analysis in spreadsheets.

Service firms should seriously investigate the teamwork tools. Some of these (such as customer relationship management) can be purchased as online services. Similarly, you can use the online office tools (such as those provided by Google) to support project teams. However, it is relatively inexpensive to run your own SharePoint server and provide complete teamwork solutions. Even without these tools, firms should find ways to store knowledge documents in a location and format that can be searched and retrieved to save time on the next project.

Decision support tools and expert systems can be added to a firm at almost any time. The challenge lies in identifying areas that can benefit from these tools, and then determining whether the potential benefits exceed the costs. Complex ana-

Reality Bytes: Self-Publishing Pays Off

For decades, even centuries, publishers have controlled access to bookstores. Almost anyone can write a book, and anyone can hire an editor and graphics artist to make the book look nice. But publishers controlled the distribution to the main bookstores. Without a contract, the number of books any person could sell was tiny. And publishers denigrated "self-published" books as books that were not worthy of reading because they had likely already been turned down by a big publisher. Of course, big publishers had financial incentives to sign a small number of authors, so many good authors fell through the cracks. The shift to electronic books—heavily pushed by Amazon—has changed the world. Karen McQuestion is a good example. She took one of her books to Amazon and eleven months later had sold 36,000 copies for the Kindle. Amazon is going to print a paperback version of one book and she has a film option with a Hollywood producer. Several sites help authors create, edit, or distribute e-books. Some of the large sites are: Amazon, Apple, Lulu, Smashwords, Scribd, and FastPencil. Compared to the almost trivial 12-15 percent that traditional publishers pay to authors, Amazon pays 70 percent of the revenue to the author, depending on price. Apple likewise takes a 30 percent cut. Even top-selling authors have moved some of their back-list titles to e-books—making them widely available at lower prices. Joe Konrath, writing as Jack Kilborn says he earned about $30,000 selling his novel "Afraid" in all forms through a traditional publishers. He estimates he could have made that much in 18 months selling 800 e-books a month on Amazon. He notes that he is already making more from self-published Kindle e-books that had been rejected by traditional publishers. He commented that "I'm outselling a bunch of famous, name-brand authors. I couldn't touch their sales in print."

Adapted from Geoffrey A. Fowler and Jeffrey A. Trachtenberg, "'Vanity' Press Goes Digital," *The Wall Street Journal*, June 3, 2010.

lytical tools can carry high up-front costs, but they can easily pay for themselves if they save money on operations that are repeated hundreds or thousands of times. The important point is to understand the business well enough to know what areas need to be fine-tuned and then to know the current capabilities of the tools.

Strategies

By definition, small businesses have relatively weak strategic power compared to rivals, suppliers, and customers. A small manufacturer is not going to go to Wal-Mart and insist they use a specific online ordering system. On the other hand, you can use this disparity to your advantage. If you want to build electronic links to large customers, simply ask to use their systems. Most large companies have sophisticated ERP systems that are already Web based and support links to suppliers. Your customers could easily configure an account for you on their systems that enables you to track all orders, shipments, and payments online. All you need is an Internet connection and a Web browser. Similarly, you can set up online accounts at major suppliers. For instance, you can buy all office supplies online at large chains such as Office Depot. Their system tracks purchases, handles electronic payments, and supports manager approval so you can monitor and control all of your office supply purchases. Since the technology is readily available, many other large suppliers should offer similar services. Think about it for a min-

Level	Description	Cost Perspective
Build and manage technology yourself.	Often necessary for leading edge ideas or to customize to your management.	Expensive, difficult to control costs. Requires considerable IT expertise.
Buy commercial off-the-shelf hardware and software.	Relatively flexible today but still requires initial customization.	Mostly up-front costs and probably need consultants at the beginning.
Online service providers.	More options today. Easy to share data. Less worry about security and backups.	Minimal up-front costs. Flexible pricing and growth.
Buy low-end tools and patch together.	Many small businesses survive with Microsoft Office and an accounting package.	Can be low-cost, even go with open source software.

Figure 11.8

Selecting technology levels. Small businesses often lack money and expertise. It is important to match the technology level to the resources of the business. Different applications can choose different technology levels. Operations are critical and can justify more expensive tools. Systems for tactics and strategies might need to search for lower-cost options.

ute—you have just shifted most of your transaction processing onto your suppliers and customers, giving you access to your data at any time with no major out-of-pocket costs.

Strategy is difficult for any firm, and harder for small businesses that lack money and power. Probably the two most important concepts are (1) Identify a strategy and purchase technology to support that strategy, and (2) Be flexible and willing to change strategies if something is not working. For instance, if your strategy is to be the least-cost provider, then select technologies that will reduce costs. But, keep an eye on new technologies as they appear because something might arrive that offers new benefits. Least-cost does not mean cheap or that you cannot buy anything. For example, a service firm might benefit from using SharePoint, even though it carries a hardware cost, the improved productivity could more than offset those costs.

That line between low-cost and useful technology is always difficult, and often requires additional training. Many small businesses eventually purchased personal computers, but gained little because they did not know how to use the tools to share and analyze data. The PCs replaced typewriters and provided some useful features, but even today many businesses could gain more with the analytical and collaboration tools.

Selecting Technology Levels

As summarized in Figure 11.8, much of the discussion of technology in small business reduces to a decision of choosing the appropriate level of technology. Does the firm need state-of-the-art technology or a dusty PC sitting in the corner? It is tempting for small firms the save money and stick with minimal costs and old technology. On the flip side, suppliers and vendors will try to sell the latest complex technologies to every business, regardless of size or needs. The decision is difficult because the answer depends on the people as well as the industry and technology. If managers are not comfortable sharing files and working on documents together, there is no point in building a collaboration system, even if it could make everyone more productive. Larger companies might be able to train workers and simply order them to use the new system. Companies with a limited number of employees are more likely to let the users make decisions. So you have to talk to all of the users to evaluate the level of technology to choose.

Buying hardware and software is only one factor in creating an information system. For small businesses, often the most critical problem is the cost of MIS workers. Remember that support workers are back-office expenses that do not appear to contribute directly to increased sales. Sometimes they can be justified in terms of reducing operations costs or improving worker productivity. But small business owners will always be critical of hiring workers.

One of the most important aspects to technology today is the ability to obtain complex services online. It would rarely make sense to put an ERP system into a small manufacturing firm with 10 employees. Among other reasons, the company will not have the MIS personnel to run the system. On the other hand, it is possible to use a sophisticated ERP system through online services for a fixed monthly fee, without needing to add expensive MIS workers and hardware.

Turn-key systems are the other popular way to reduce the need for MIS workers. Most turn-key systems provide service contracts and at least telephone support. Although the contracts might seem expensive, they can be justified by avoiding the fixed-cost of hiring MIS workers.

Managing Consultants

Because small businesses are reluctant to hire permanent workers, they often end up hiring consultants. Or, they try to get free advice from consultants, friends, and academics. The big consulting firms tend to charge relatively high fees. The work might be worth the amount of these fees, but managers need to think about what they are getting for the price. Specifically, in terms of technology, managers need more than the final product or report produced by the consultants. Managers should look at consulting as an educational opportunity and use the time to extract as much knowledge as possible. Then if you need support in the future, you have a head start and might even be able to perform the basic tasks yourself.

Consider a simple example where you need a LAN installed. Assuming you know nothing about networks, you hire a firm to select the hardware and install everything for you. You, or one of your employees, should observe the consulting team, ask plenty of questions, and get full copies of documentation. When the business expands and you want to add a couple of computers to the network, you should be able to consult your notes and the documentation and add the new computers yourself instead of having to call the consultants back and pay more money. Similarly, if the cleaning group unplugs the network switch some night and nothing works in the morning, you can perform basic troubleshooting and solve the problem quickly and inexpensively.

Like any other purchase, you need to evaluate multiple consultants before hiring one. Check references, get recommendations from other clients, and negotiate contracts. Be careful of low-cost bids. Be sure that contracts completely spell out all work and costs. Most small businesses prefer to work with fixed-price contracts, but many consulting organizations will balk—preferring to charge by the hour. If you cannot get a fixed-price contract, you will have to be careful about what you ask for. Any changes or requests you make will cost additional time and money. So, begin with a concise statement of what you want done and refer back to it often.

Internationalization

The declining price of information technology makes powerful tools accessible to even small businesses. The Internet and VoIP make it possible to communicate globally at minimal costs. Web and auction sites make it easy to sell products around the world, and large payment systems like PayPal and credit card processors handle currency conversions automatically. The giant shipping companies (UPS, DHL, and FedEx) handle worldwide delivery and customs regulations almost automatically. With these tools, small businesses can compete with almost any large company.

Small businesses can even hire workers in foreign nations. Without leaving your desk, you can use online worker-matching Web sites (e.g., rentacoder.com) to advertise and find someone in a low-wage country to work on your project. Yes, you have to stay up late at night to talk directly to the workers, but the tools are available and if that is what it takes to save money and acquire the expertise you need, it is a small price to pay. If you need a more traditional relationship within a country, you can use the services provided by most state governments. Most of the states have established exchange and international promotion programs in various countries. You can use these programs to initiate contacts with foreign government officials, potential manufacturers, and distributors in various countries. Sometimes all you need is a phone number and initial contact to get started in your search.

Entrepreneurship

How do you start a business? How does technology help? **Entrepreneurship** is the act of building and running a business. The term is generally applied to new businesses, but it is becoming common for large businesses to encourage entrepreneurship within the main organization. For instance, a manager who comes up with an idea for a product might seek support to run a new project within the larger company.

Entrepreneurship is built on three broad fundamentals: (1) an idea, (2) a business plan, and (3) implementation. Risk is a fourth important element. You should not consider becoming an entrepreneur unless you are willing to deal with risk of loss—loss of time and loss of money. However, having a good idea, building a solid business plan, and managing the implementation carefully can reduce risk.

Flexibility is another important characteristic of successful entrepreneurs. The problem with having a new idea is that it is difficult to forecast exactly how it will be received by customers. Hence, many ideas and plans began in one direction, and only succeeded when the managers used the information to change directions and find a more profitable solution. Along the same lines, a thousand unforeseen obstacles can leap into the path of any good plan; flexibility and perseverance are important to circumventing these problems.

Idea

How will your business be different from the existing firms?

Ideas are the foundation of entrepreneurship. There is little point in starting a business or project just to copy someone else. The idea could be a new product or service, or it could be a better method of production, or a better marketing or financial system.

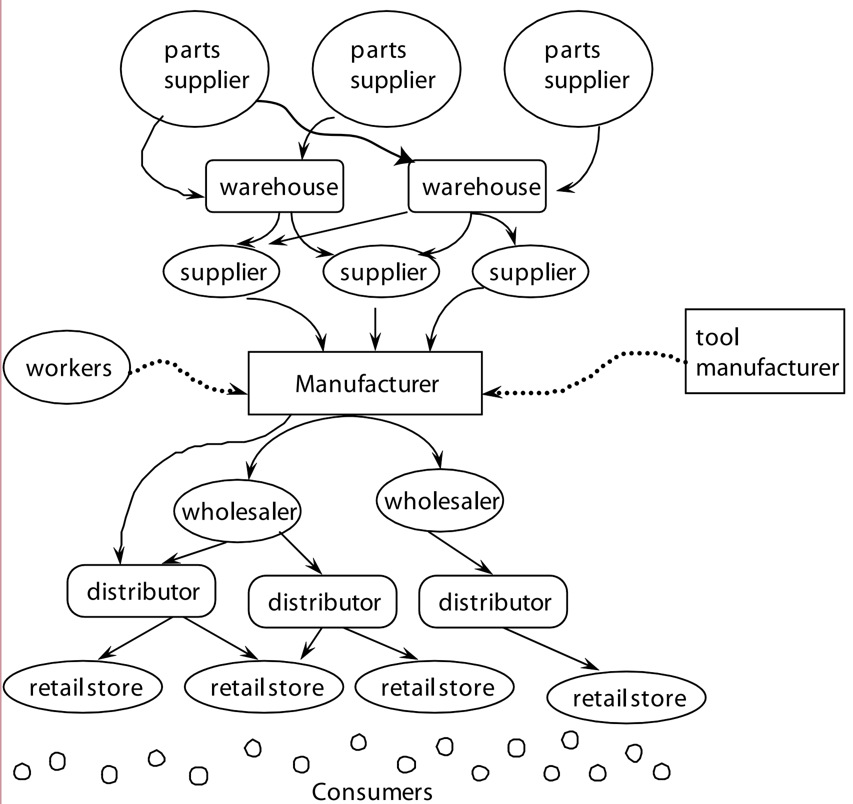
Ideas are closely tied to strategy. As a start-up firm, yours will be small and must have a clear focus. Are you trying to be the least-cost producer to attract customers from older firms? Or are you planning to offer radically new products and services that provide greater benefits than the competition? A successful strategy will depend on a careful analysis of the industry and your role within it.

Strategy

The key as an entrepreneur is to examine the many aspects of strategy to find and clarify an idea. For entrepreneurs, three key strategic issues are (1) an understand-

Figure 11.9

Production chain. When starting a business it is critical that you examine the entire production chain to identify the 800-pound gorillas and figure out where the profits are made. If the niche you are looking at has too much rivalry, you might consider a different spot on the chain.



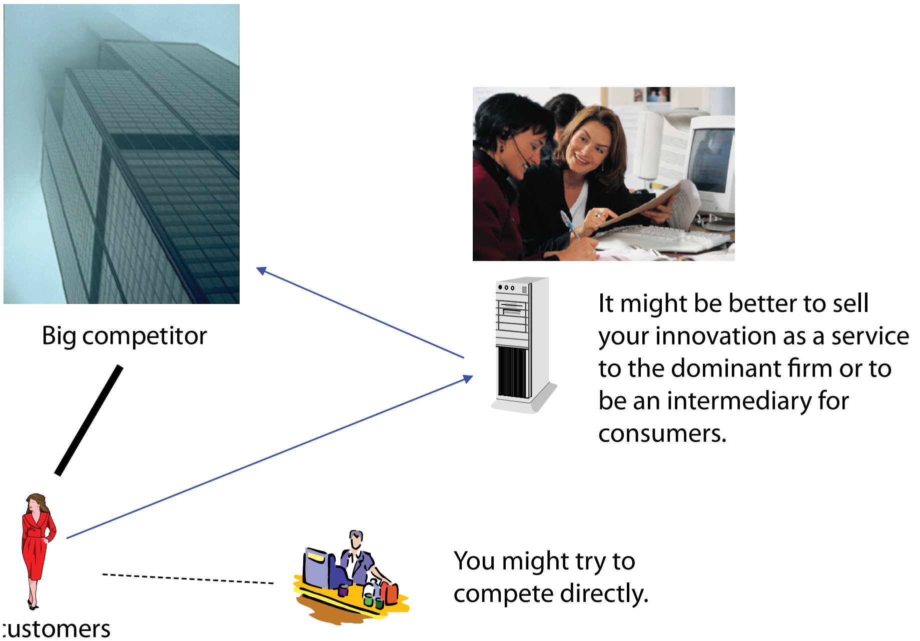


Figure 11.10

Expand your focus. When searching for ideas, it might be better to partner with a large firm instead of competing head-on.

ing of where you will stand on the production chain, (2) identification of the competition and substitute products, and (3) barriers to entry.

As a new firm, yours will most likely be one of the smallest. Even if you start an entirely new concept or industry, you will be dealing with an entrenched base of suppliers and customers. As a newcomer, your business clout will be small, so you will not be able to count on discounts or goodwill from your suppliers.

Figure 11.9 shows a generic production chain. When you are looking for ideas, you should examine the production chain for various industries. Get information on the leading firms in each step of the chain. Determine the concentration ratios. Do four firms control 50 percent of the market at a given level, or are there many small firms with no dominant player? Look at the final price and profit of the product or service, and then trace backward and identify the various costs and profits at each level. Then combine your analyses. For example, if there is a reasonable profit at the consumer level, it might appear to be a good opportunity. But if only a few dominant firms supply the product, then these firms might be thinking about expanding into consumer sales—or they might make it difficult for you to create a new retail firm.

Even if you have an idea that creates an entirely new industry, your firm will face competition. You must carefully identify your closest competitors and also specify any potential substitute products. You can also use this analysis to generate new ideas. As a consumer, look at the products and services you buy and identify the main competitors and the potential substitutes. E-commerce specifically looks at the steps that consumers must go through to purchase an item. Can these steps be simplified? Can additional services or products be offered at the same time using information technology?

- Competition
  - Number
  - Concentration ratios
  - Sales by firm
  - Technology plans
- Size of the market
  - Number of customers
  - Growth rate
  - Market comparison for substitute products
  - Consumer focus group interviews
- Production costs
  - Startup/fixed costs
  - Operating costs
- Legal environment

Figure 11.11

Business research. You need to collect data on competitors, the size of the market and how it is growing, production costs, and the legal environment.

When searching for ideas, expand your focus to include different aspects of the problem. For instance, perhaps you can create an expert system to help customers select features of a product. You might think about creating a retail store or a Web site to sell that product. But perhaps a few large firms dominate the retail side, or it requires expensive advertising to enter the market. In this situation, as shown in Figure 11.10, it might be more profitable to build your system and sell or lease it to the existing retail firms. Or you could create a service Web site that other sites can connect to and pay a fee for each use of your system.

When evaluating ideas, you must always consider the issue of barriers to entry. If you do have a great idea, and your company makes a profit, how are you going to keep rivals from entering your industry and taking away your customers? If you create a new business process or new software, what will stop others from emulating your system? Chapter 10 examines some of the typical areas firms consider to create barriers to entry. As a new, small firm, the economies of scale, capital requirements, and control over distribution are not likely to apply to you, except negatively. Also, remember that there is a fine line between creating barriers to entry and violating antitrust laws. So far, most IT barriers have been considered acceptable as long as you do not coerce people to use them.

In the United States it is still possible to obtain patents on business processes. These patents were popular in the early days of the dot-com expansion, but the patent office began to take a closer look and deny some obvious ideas. If you have a truly new process, you might be able to patent the concept—preventing anyone else from copying it for 20 years. Of course, a single patent can cost $10,000 to $30,000 or more to obtain.

Research

Research is closely tied to idea generation. As you evaluate alternatives, you need to obtain current data on several items. Figure 11.11 summarizes some of the basic data that you will need.

Insights	http://www.google.com/insights/search/#
Trends	http://www.google.com/trends
Zeitgeist	http://www.google.com/zeitgeist

Figure 11.12

Find what people are searching for. Google has several tools that enable you to search through the searches. You can see what items are popular and how the searches change over time or season. Tons of data but they provide a view into consumers' minds.

Broad industry information can be obtained from various government Web sites or publications. More specific data can be obtained from the companies themselves, if they are publicly traded. Sales data and more detailed comments on rivals can often be purchased from marketing companies. A few companies monitor Web site traffic, so you can obtain basic online activity data for some of the larger firms. Customer focus interviews are important. At some point, you need real-world feedback on your ideas.

Production costs and other hints can be obtained from suppliers and salespeople. If you are serious about developing a presence in a particular area, scour the trade journals and find some of the leading suppliers. Call the regional sales representatives and they will provide detailed information on items that you will need. But be sure to compare prices from several firms.

Even for retail firms, several legal hurdles must be cleared. Some industries have more complications than others, so you need to carefully investigate all laws and rules that might apply to your business. Find out if there are restrictions on what you will be allowed to do. In terms of permits, identify the permits you need to obtain, exactly where to get them, how often they need to be renewed, the cost of the permits, and the time frames between application, inspection, and approval.

Information technology can be used in several areas to help obtain and evaluate research. Clearly, the tools examined in Chapter 9 can be applied to analyze data. The problem for new firms lies in finding the data. Today, much of the data is online. Government agencies provide summary data by industry (particularly the Census Bureau). The Securities and Exchange Commission (SEC) provides standard financial reports online. Other sites, such as WSJ.com and finance.Yahoo.com consolidate that data and provide tools to quickly compare and chart firm and industry data. Other specialist firms track detailed sales data. For instance, you can purchase detailed data from supermarket scanners for any level of products or geographic location.

Another useful source of data is Google—but in a slightly different way. Yes, you can search for competitors. You can also use AdWords to estimate the potential response to different keywords. But, Google provides even more powerful tools. Figure 11.12 lists the three main tools: Insights, Trends, and Zeitgeist. They are related, but provide slightly different interfaces. Insights is probably the most general. It is essentially a search of the keywords people are entering. It has tools to look through categories, seasonality, geography, and other properties. You can build custom searches to examine any set of words or features. For instance,

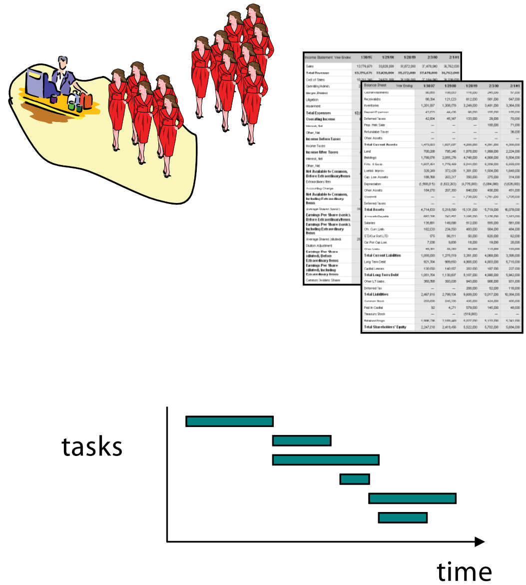


Figure 11.13

Business plan. A business plans helps you organize your ideas, provides a roadmap and schedule, and provides financial targets to use as benchmarks as you move forward. It is also critical for obtaining investment funding.

you could examine how often and when people search for a particular product—and then see how those searches differ by time of year and location. The zeitgeist site provides a more general look at things people are searching for—around the world. The main Twitter Web page provides a similar concept by displaying the currently most popular tweet subjects.

Remember that people use Google searches for almost everything today. These tools provide the ability to look into their minds and see what is important. If you want to know if people might be interested in your product or idea, go see how many people are searching for it. Because Google stores these statistics, you can get a view of ideas and topics over time. (Did consumers respond to an advertising campaign by running searches?) You cannot obtain searches made by specific individuals, but marketing research is all about identifying patterns based on similar locations and times. Oh, and this data is free of charge.

Plan

How do you turn an idea into money? Millions of people have ideas; only a few are able to create new businesses and turn them into money. Once you have identified a reasonable idea and done the basic research so that you understand the industry, you need to write a business plan. The purpose of the plan is to create a road-map that will help you set up, manage, and evaluate your progress. It is also critical to obtaining external financing. In 2000, the heyday of Web start-ups, there were stories of entrepreneurs obtaining financing on the basis of a short PowerPoint slide show. Those days are gone. A detailed business plan will convince prospective investors that you are serious and that you know what you are doing. It will also help them evaluate the true potential of your ideas.

Technology Toolbox: Sending E-Mail Legally (CAN-SPAM)

Problem: You need to send e-mail to potential customers to advertise.
Tools: The CAN-SPAM Act of 2003 (Controlling the Assault of Non-Solicited Pornography and Marketing Act) 15 USC Chapter 103 defines the rules you need to follow to send commercial (advertising) messages.

E-mails that are "transactional or relationship messages" (i.e,. existing contacts) are not required to follow the rules. The Act requires

(1) **All header information to be accurate.** Header information includes the originating e-mail address, IP address, and the "from" line. Spammers routinely alter this information or hijack other e-mail accounts to make it more difficult to track them down.
(2) **Subject headings must be accurate.** Hard to define but usually obvious. You cannot deliberately lie in the subject heading. Spammers often use false subject headings to convince people to open the message.
(3) **E-mail must contain an electronic opt-out mechanism.** It must be functional for at least 30 days. You must also include a valid physical (postal) address.
(4) **You must stop sending messages if a person opts out.** You must stop sending messages within 10 business days. The long delay is a problem for users because they have to track their request date; but it gives senders a chance to update databases with e-mail senders.
(5) **No e-mail address harvesting.** You cannot extract e-mail addresses from Web sites, domain registration lists, random generation, and so on. Spammers commonly do these things, but it can be difficult to prove, unless someone deliberately sets up a trap.
(6) **Sexually explicit messages must be identified.** An FTC interpretive rule requires that sexually oriented messages must include the line "SEXUALLY-EXPLICIT" in the subject line. If people actually follow this rule, it is relatively easy to define rules that block those messages.
(7) **The Act applies to the sender and the advertiser.** Even if you hire someone who sends the message, as the company or Web site being advertised, you can be held responsible for violations of the Act.

The Act provides for fines of up to $11,000 per violation—which could amount to millions of dollars. Enforcement is charged to the FTC, and the FTC is supposed to be the one to take charge. Individual users do not have legal standing—which means that as a recipient, the most you can do is complain to the FTC or to your ISP. Currently, most cases have been pursued by Internet service providers—notably Microsoft. Paragraph (g) of section 7706 permits civil lawsuits by ISPs—on the grounds that the spammers are stealing bandwidth.

Quick Quiz:
1. Has the Act reduced the level of spam?
2. Why would spammers risk violating the law?
3. What other provisions would you want to include?

You can purchase software that will help you organize the business plan, but you must still collect the data and write the descriptive sections. You must also be careful when using some software templates. When potential investors see plans that are simple fill-in-the-blank templates with little additional content, they do not believe you spent much time on the plan, and are not serious about the business.

As shown in Figure 11.13, the goal of the plan is to precisely describe the business you wish to start (or expand), the market environment, and your strategy. You must also include financial analyses using forecasted sales and costs. You should include a timetable that indicates how the company will need to grow. Based on these projections, you will be able to determine the amount of money you need to raise to run the company over the next three to five years. In terms of presentation, you must also include an executive summary that is a one-page review of the major points.

Strategy, Competition, and Market Analysis

The strategy section is based on your research of the market. It contains several subsections that describe exactly what products or services you will produce. It should identify the major competitors and estimate the size of the market and how it will change over time.

If you are creating or distributing products, you need to identify your suppliers, including backup suppliers if something happens to your primary source. For products, it is also critical that you describe your distribution network. Will you distribute through standard retail stores? Ship products by UPS? If there are multiple layers, it is particularly critical that you identify how you will track shipments and sales through the process.

Forecasts, Cash Flow, and Investment Budget

The financial section is a primary component of the business plan. For a start-up firm, it can also be one of the most difficult to create. This section includes estimates of sales and costs. You will have a separate section for start-up costs and ongoing costs—this section is relatively straightforward, but you have to contact several suppliers and contractors to get good estimates of the costs.

The more challenging aspect of the financial section is the need to forecast sales by month for at least three years, and annual sales for five years. Figure 11.14 shows that the sales forecast is the foundation for the other financial data. The level of sales directly determines the revenue, the marketing costs, and the cost of goods sold. Once you know the sales level, you can determine the scale of the infrastructure needed to support those sales, for instance, the size of the Web server and Internet connection speeds in an e-commerce world, or size of distribution facilities in a traditional retail environment. The size of the firm also determines the number of employees needed, which identifies the cost of salaries. Salaries can be a significant component of some firms. Note that for e-business firms, you might require a larger number of contract employees to develop software in the beginning. Once the system is operational, you may be able to run with a smaller core group of employees. These costs should be recorded in a separate start-up cost statement.

With sales, cost of goods sold, infrastructure costs (leases and so on), and salaries, you have estimated the primary costs and can create projected financial statements. You need to estimate a growth factor for each month or year. This growth factor is one of the most subjective elements in the projection. However,

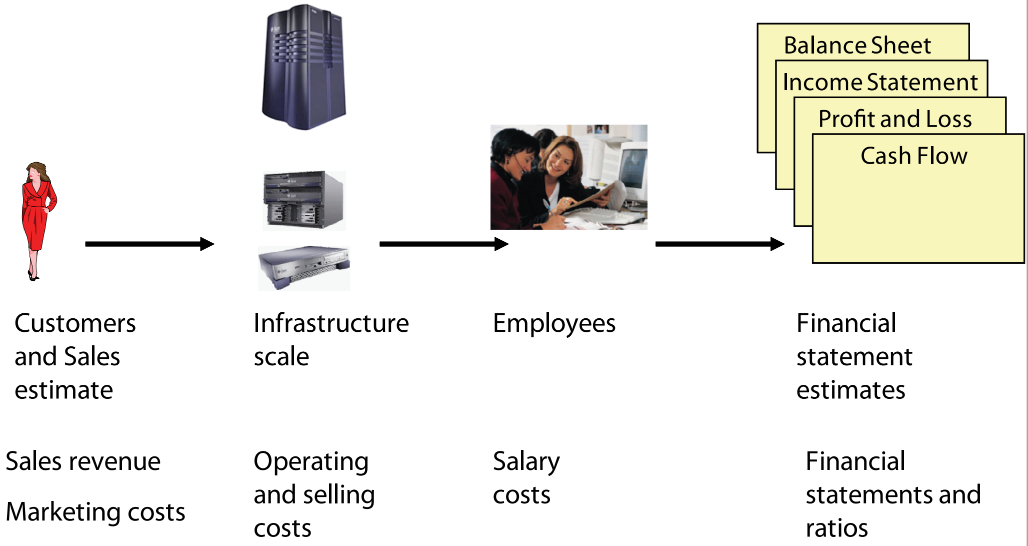


Figure 11.14

Estimating financial statements. The estimate of sales determines the size of the infrastructure and the marketing and purchasing costs. The number of employees needed can be determined from the size of the firm and provides the estimate for salaries. With these major points, the financial statements can be projected to identify the cash flow and the amount of investment money needed.

you should try to estimate growth rates of similar firms and keep your numbers in a reasonable range. Also, higher growth rates will mean that you need greater marketing expenses to obtain that increase in sales.

With the basic financial statements estimated, you can concentrate on cash flows. When will money arrive? Will there be delays in payments? Many of your costs occur up front or on a monthly basis, so calculate these and estimate the firm's cash position for each month. You will need a source of funds to cover times when the cash flow is negative. You should do the same for profit, so that you have an estimate of when the firm will become profitable.

Of course, you still face the problem of estimating the level of sales, which can be next to impossible for new products or services. If there is no way to generate a plausible sales forecast, it might be better to start with an estimate of the infrastructure size. From there it is generally easy to estimate the fixed costs. Now, examine various levels of sales to pick up revenue, cost of goods sold, and marketing costs. As shown in Figure 11.15, you can now compute total cost and revenue for varying levels of sales. The point where the two are equal (where the lines cross) is the break-even point. You must reach this level of sales before you can make a profit. Now, compare that sales number to similar firms. If the sales number is too high, it is unlikely that your venture will be profitable. Conversely, if it is substantially lower than for other firms, you are probably overestimating the price you can charge, or you are missing some costs. If the lines never cross—you have a major problem: the firm will never be profitable based on your estimates.

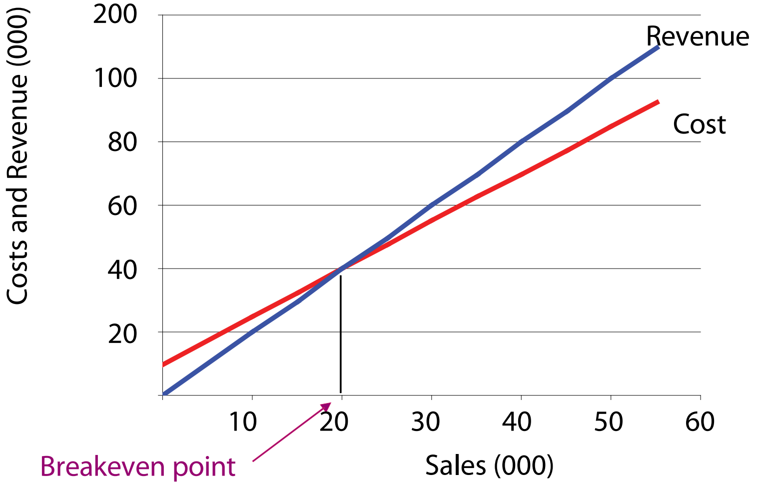


Figure 11.15

Break-even analysis. If it is too hard to forecast sales, you can choose an infrastructure size and estimate fixed costs. Then estimate variable costs and revenue per unit sold. Compute total cost and total revenue for varying levels of sales. Look for the break-even point. That is the minimum level of sales you must be able to reach to be profitable.

Marketing

As part of the business plan, you will have to create a marketing plan. The marketing plan will begin with the anticipated sales level. Then it will identify the target customers with as much demographic detail as you can obtain. Income level is critical. Regional location could be important for some businesses. It is also desirable to find out what magazines, newspapers, television shows, and radio programs the consumers prefer. If you are selling to other businesses, you should identify trade groups that are likely to represent the target businesses.

The marketing plan should contain an analysis of pricing. At a minimum, you should survey consumers, or create a focus group, and find out how much the potential customers are willing to pay for your product or service. You should also identify points for quantity discounts, particularly if you are selling to other businesses.

You then need to create an advertising plan. You need to find prices and viewer demographic data for newspapers, magazines, radio, television, and Web sites. You might also consider alternatives such as direct mail, billboards, and tie-ins with other products. For local promotions, you can contact advertising managers directly. For nationwide campaigns, you will want to hire an advertising design and placement firm. While it increases your costs, the experience and contacts of the firm will save you time and help focus your campaign.

You will also need to create a sales management plan, where you focus on the internal structure of the marketing department. How many salespeople will you need? How will they be paid and what additional incentives will you provide? How will you handle customer complaints? What tools will you use for

- Bans false or misleading header information. "From," "To," and routing information must be correct.
- Subject lines cannot be deceptive.
- The e-mail must provide an opt-out method that works and these requests must be honored within 10 business days.
- The message must be identified as advertising and must include the sender's valid physical address.
- Sexually explicit messages must be identified according to FTC rules.
- Only ISPs (not individuals) have standing to sue spammers—for wasting their bandwidth.

Figure 11.16

CAN-SPAM Act provisions. Although the Act is completely ineffective at reducing unwanted e-mail, businesses should follow all of its provisions to avoid being fined.

customer relationship management? How will you identify and build cross sales of products?

Online Advertising

As a startup or small business, particularly an e-business, online advertising can be critical to your success. Online advertising has changed over time—largely led by Google's innovations in charging for keywords. This process is explored in Chapter 7. The main step is to analyze the returns from each ad so that you can correctly set per-click prices as well as daily budgets. As more people search online, the ads can be effective to introduce your Web site to new customers.

To reduce your costs, you want to find mechanisms so that customers return directly to your site, instead of repeatedly going through Google. Every time a customer clicks through Google ads, you have to pay again. It is better to get them to return directly to your site. You can improve this process by selecting a Web site address that is easy to remember and associate with your product. The drawback is that many simple site names are already taken, either by competitors or by domain squatters who do not use the site but will be happy to sell it to you for an exorbitant fee. Another useful technique is to add links to your site that make it easy to add your Web site to the customer's list of favorites.

Once you have a list of customers, you can send them e-mail messages announcing sales or special deals. Actually, the U.S. **CAN-SPAM Act** of 2004 allows you to send e-mail messages to almost anyone. However, in all cases, you must be careful to follow the rules of the law or you can be fined up to $11,000 per violation. You must also be careful about laws in other nations. Many U.S. states also have laws against unsolicited commercial e-mail, but these laws are generally superseded by the CAN-SPAM Act. Consult an attorney if you have any uncertainty.

The basic provisions of the CAN-SPAM act are listed in Figure 11.16. The Act has been completely ineffective at stopping or reducing unwanted e-mail (spam). However, it is important to recognize that the Act makes it legal for businesses to send e-mail messages to customers and potential customers. So, e-mail can be used as a marketing tool—as long as you scrupulously abide by all of the provisions of the Act. Any deviation could be punished by fines, but more importantly, it will annoy potential customers and they will shop somewhere else. E-mail is particularly helpful in dealing with existing customers and expanding their purchases. Just be sure to include privacy notices and opt-out choices. There is no point in sending e-mail to customers who do not want it.

Of course, because the Act was unable to make a dent in spam messages, your real problem lies in writing subject lines and messages that will make it through the spam filters on your customers' e-mail systems. This question has no fixed answer because spammers and filters continually change formats and rules. You can keep separate testing accounts with major e-mail providers and check your messages to see if they survive.

The other major issue you will face is that you should contact your ISP before sending out hundreds or thousands of messages. Most ISPs have automated tools to watch for potential spammers on their networks and they might shut down your account. In most cases, the easiest solution is to contract with a separate company to handle your outgoing e-mails. Several companies specialize in maintaining your e-mail lists and sending thousands or millions of e-mail messages. However, be careful when evaluating these companies—some are just spammers in disguise. Be sure that you work with a company where you provide your own lists and ask for a list of clients so you can verify that they deal with real companies.

Organization and Timetable

You need to specify the organizational structure and create a project timetable to provide a road-map and benchmarks so that you can evaluate your progress. For the management, you need to identify who will fill each of the primary roles. If you are using the plan to raise money, you need to include a brief biography of each person. If there will be more than a handful of employees, you need to draw an organizational chart. You also need to indicate how the structure will change as the firm grows.

For complex start-ups, a project management timetable can be invaluable. The thousands of management tasks from government filings, construction, purchases, writing programs, hiring people, managing advertising, and dealing with suppliers can quickly bury you in details. You need a timetable to record when tasks should be started, and which tasks depend on others, and to track which tasks have not been completed. A project management package is a useful tool to handle all of these details. It can also track assignments by employees and has tools to help you identify bottlenecks and times when you might need to hire additional people.

The timetable should also be integrated with the financial forecasts so that as the company moves forward, you can evaluate your progress. If you do not reach a certain sales level at the forecasted time, you can adjust your future growth rates and recalculate the amount of investment money you will need in the future.

Implementation

Is it true that genius is 1 percent inspiration and 99 percent perspiration? Yes, most likely, Edison was correct. Ideas and planning are only the beginning of creating a business. The real work begins with implementation. The true job of an entrepreneur is to devise the rules and procedures that make a business successful. Once the plans are in place and you know how much it is going to cost to get started, you need to form the legal company and obtain

- State forms
  - o Articles of incorporation
  - o Corporate Bylaws
  - o Registered Agent (self)
  - o Business Registration Form
    - State Employer Number
    - Withholding ID
    - Sales Tax ID
  - o Additional licenses
- Federal forms
  - o SS-4 Application for Employer Identification Number
  - o 2553 Election by a Small Business Corporation

Figure 11.17

Primary forms to start a business. Companies are incorporated by the state, and states have different requirements and filing fees. Companies must also obtain an EIN from the IRS. The S corporation election is optional, but popular with small businesses.

financing. You probably need to hire an initial staff, and you need to create an accounting system to record all transactions and monitor your progress.

Starting a firm requires a considerable amount of paperwork. Some of the basic steps are shown in Figure 11.17. Some types of firms require dozens of licenses, and if you need to construct or remodel facilities, you will need additional permits. One of the first decisions you must make is to choose a state in which to incorporate. Each state has different rules, procedures, and fees. Delaware is a popular choice because of the way its laws are written. But small businesses may find it easier to file with the state in which they are located. Then the company can be its own registered agent and can avoid paying franchise fees to two states. Even if you incorporate in Delaware, you will still have to register in each state that you have a physical presence. A few companies specialize in helping you incorporate a new company for a fee. You answer a few basic questions, and the firm fills out boilerplate articles of incorporation and bylaws and files them with the state of your choice.

Ownership Structure

One of the more difficult decisions to make is the legal structure of the firm. Simple partnerships are relatively easy to create and to register with the state. However, partnerships generally cannot issue stock and it can be harder to protect the partners from lawsuits. Corporations stand as separate entities and can issue stock, but the accounting requirements are a little more time consuming, and you face a double-taxation issue. Any money the company makes is subject to corporate income taxes, and dividends that you pay to owners are subject to personal taxes. Most states enable you to create a **subchapter S corporation** or a **limited liability company (LLC)** to combine features of partnerships with those of corporations.

Most small business start-ups choose one of these two structures. With both forms, income and losses flow directly to the owner's income statements and are only taxed once. Both protect the owners from lawsuits, as long as you keep a

Reality Bytes: Sales are Good, Now Collect the Money

Ask almost any entrepreneur which problem they hate the most and they are likely to say something about collecting money from customers. Not just selling—actually getting the customer to pay. Service-based firms typically contract the work and then bill the client. Small firms are slow to pay because they are struggling with cash flow. Big firms are slow to pay simply because they can. When the economy turns down, delays get longer. Several online sites now make it easier and cheaper to check on potential customers before signing contracts. Cortera (www.cortera.com) provides a business directory and basic data about payment history. Larger credit-reporting bureaus include Dun & Bradstreet (www.dnb.com) and PayNet (www.paynetonline.com) which track payment history and provide basic credit ratings. All of them charge fees for their services, but for it is possible to get basic data for relatively low cost. Companies that sell to individual customers can also do background checks, but most of the time it is easier to use standard payment methods including credit cards and PayPal. Several tools make it possible to swipe credit cards using cell phones to get immediate payment data almost anywhere.

Adapted from Raymund Flandez, "Three Best Ways to Make Sure Customers Pay," *The Wall Street Journal*, November 13, 2009.

solid line between company business and personal funds. The primary difference between them is that the LLC is not a corporation and cannot sell stock. The S corporation is also easier to convert into a standard (chapter C) corporation. States have different interpretations of the LLC, so your choice of structure depends on the state in which you incorporate.

Financing

Obtaining financing is related to the type of business structure and the size of your firm. The two choices are debt and equity (stock). However, as a start-up, you will find it difficult to find a bank willing to lend you money. Banks will lend money for relatively liquid assets, such as inventory. But they will generally not lend over 80 percent of the value. Most start-up businesses find investors and grant them partial ownership through shares of stock.

Debt

Firms can borrow money to finance certain things, but it is difficult to borrow money for a start-up. Banks know that many small businesses fail within the first year, so they prefer to lend to an established business. Some banks specialize in merchant loans to cover some of the costs of buying products that will be sold at retail. But even in these cases, the company will have to provide cash to cover some of the costs. Larger firms can sell bonds on the market for long-term debt, but it is unlikely that anyone would be willing to buy bonds from an unknown start-up company. Borrowing money also entails interest payments, so the cost can be relatively high.

Equity

Most entrepreneurs search for investors willing to provide start-up capital in exchange for partial ownership in the form of shares of stock. Figure 11.18 shows

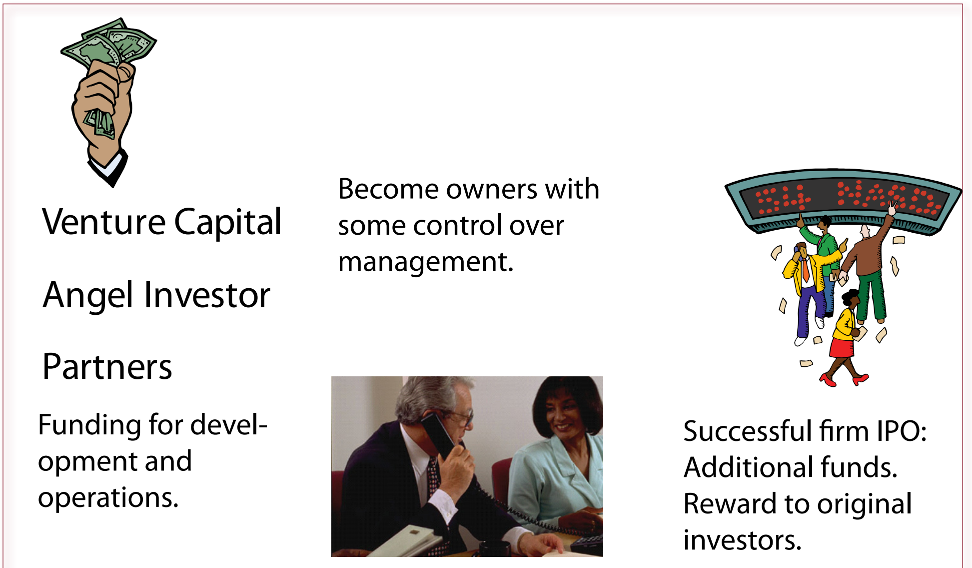


Figure 11.18

Start-up financing. Venture capital firms and partners are given ownership positions and sometimes provide management control in exchange for development funding. If the firm is successful, it issues an initial public offering of stock, which funds additional operations and rewards the original investors.

that **venture capital (VC)** firms exist specifically to provide funding to start-up firms. An entrepreneur generally presents the business plan to a VC firm, with a detailed budget and a request for the money to cover development and operating costs for the first year. VC firms evaluate hundreds or thousands of proposals in terms of the strength of the idea, the ability and track record of the management, and the potential profits. VC firms expect many of the small companies to fail, but to cover the losses by having a few firms with enormous returns.

Once the firm is established and potentially profitable, the managers take the firm public by issuing stock at an **initial public offering (IPO)**. The public stock raises additional money and eventually gives the entrepreneur and the VC firm an opportunity to sell some of their shares for a personal gain.

In a hot market, start-up firms can often trade initial private shares of stock for many items they need. For example, many managers are willing to accept smaller salaries in exchange for stock options. **Stock options** are granted by the firm at a specific price. If the firm goes public and the stock price increases, the employee buys the stock from the company at the option (low) price and sells it for the higher public price. As an employee, keep in mind that this transaction is taxed as current income and can take one-third or more of the profit. But you need to offer stock options, because you need experienced employees willing to work for low pay in exchange for future rewards if the company succeeds.

Although equity has many advantages, remember that you give some control of the firm to the investors in exchange for their money. How much control depends on your negotiating skills, on the number of firms interested, and on the amount of money.

Technology Toolbox: Creating a Business Plan

Problem: You want to start a business.

Tools: You can buy templates and software that will help you organize your ideas and generate business plans. In most cases you are better off using a spreadsheet or accounting software to design your own plan.

The overall structure of the plan should follow a standard organization: Introduction (a summary of the company), Marketing (market analysis and pricing), Historic Analysis (sales and profits in the industry), Organization (structure of the firm and the management team), Financing (detailed budgets and cash needs), and Projections (estimates of sales, costs, and accounting statements).

Forecasting is an important, but challenging aspect to creating a plan. You need to create a complete set of accounting statements (income statement, balance sheet, and cash flow) that reflect the anticipated position of the firm for the first few years. The key to estimating these numbers lies in starting with the size of the company in terms of sales. If Rolling Thunder Bicycles anticipates selling only 100 bicycles, you could run the company with a couple of employees. If sales grow to 2,000 bicycles, you will need more employees to build and sell the bicycles. Consequently, you will need bigger facilities and more managers. In the case of RT, you would estimate sales of each type of bicycle and multiply by the average sale price to obtain an estimate of revenue. The sales number also tells you the materials and tools you need, which gives estimates of the major expenses. Now you can estimate the start-up costs to build or lease space and buy equipment. Combining these numbers with the sales revenue gives you assets and cash flow. Initially cash flow will probably be negative. This number tells you how much you have to finance, which means you will have to include interest costs. When you build the spreadsheet, you should set up a page of constants (such as percentage increase in sales) and build the formulas to refer to these cells. You can change values to see the effect of your assumptions.

Building the accounting statements yourself (perhaps with the assistance of an accountant), forces you to identify the primary financial information items. It helps you see financial relationships and the internal structure that you will have to build.

Rolling Thunder Estimated Sales
Number of Bicycles

Year	Increase	Hybrid	Mountain	Race	Road	Tour	Track	Annual Total
1		250	250	350	200	350	50	**1450**
2	10%	275	275	385	220	385	55	**1595**
3	10%	302	302	423	242	423	60	**1752**
4	10%	332	332	465	266	465	66	**1926**
5	10%	365	365	511	292	511	72	**2116**

Average Sale Price of a Bicycle

Hybrid	Mountain	Race	Road	Tour	Track
$1,000	$1,500	$2,500	$2,000	$1,000	$2,000

Estimated Sales Value

Year	Hybrid	Mountain	Race	Road	Tour	Track	Annual Sales
1	$250,000	$375,000	$875,000	$400,000	$350,000	$100,000	**$2,350,000**
2	$275,000	$412,500	$962,500	$440,000	$385,000	$110,000	**$2,585,000**
3	$302,000	$453,000	$1,057,500	$484,000	$423,000	$120,000	**$2,839,500**
4	$332,000	$498,000	$1,162,500	$532,000	$465,000	$132,000	**$3,121,500**
5	$365,000	$547,500	$1,277,500	$584,000	$511,000	$144,000	**$3,429,000**

Balance Sheet--projected at year end	Year 1	2	3
Assets			
Current Assets			
Cash	($193,550)	$3,095	$302,395
Receivables	235,000	258,500	283,950
Inventories	98,700	108,570	119,259
Pepaid expenses	1,000	1,000	1,000
Total Current Assets	141,150	371,165	706,604
Property, Plant and Equipment			
Land	0	0	0
Buildings	0	0	0
Fixtures and Equipment	250,000	300,000	350,000
Subtotal	250,000	300,000	350,000
Less accumulated depreciation	50,000	110,000	180,000
Net Property, Plant and Equip	200,000	190,000	170,000
Total Assets	$341,150	$561,165	$876,604
Liabilities and Shareholders' Equity			
Current Liabilities			
Acccounts payable	82,250	90,475	99,383
Accured payroll and benefits	0	0	0
Income taxes payable	(123,000)	(284,100)	(350,307)
Other current liabilities	0	0	0
Total Current Liabilities	(40,750)	(193,625)	(250,925)
Other Liabilities	0	0	0
Long Term Debt	0	0	0
Total Liabilities	(40,750)	(193,625)	(250,925)
Shareholders' Equity	0	(193,550)	3,095
Additional paid-in capital	0	0	0
Retained earnings	(193,550)	196,645	299,300
Total Shareholders' Equity	(193,550)	3,095	302,395
Total Liabilities and Shareholders' Equity	($234,300)	($190,530)	$51,470
Money to be raised (equity or debt)	$575,450	$751,695	$825,134

Cash Flow--projected	Year 1	2	3
Net earnings	$184,500	$426,150	$525,461
Depreciation	50,000	110,000	180,000
Net (gain) loss on asset sales	0	0	0
Other	0	0	0
Subtotal from sales	50,000	110,000	180,000
(Increase) decrease in current assets:			
Receivables	(235,000)	(23,500)	(25,450)
Inventories	98,700	9,870	10,689
Prepaid expenses	(1,000)	0	0
Subtotal from assets	(137,300)	(13,630)	(14,761)
Increase (decrease) in current liabilities			
Accounts payable	82,250	8,225	8,908
Other current liabilities	0	0	0
Accrued payroll	0	0	0
Income taxes payable	(123,000)	(284,100)	(350,307)
Total change in current liabilities	(40,750)	(275,875)	(341,400)
Total adjustments	(128,050)	(179,505)	(176,161)
Net cash provided by operations	56,450	246,645	349,300
Cash flows from Investing:			
Expended for property, plant, equip	(250,000)	(50,000)	(50,000)
Proceeds from sale of assets	0	0	0
Net cash used in investing	(250,000)	(50,000)	(50,000)
Cash flows from Financing:			
Proceeds (payments) from long-term debt	0	0	0
Stock or Additional paid in capital	0	0	0
Cash dividends	0	0	0
Net cash provided by financing	0	0	0
Net increase (decrease in cash)	(193,550)	196,645	299,300
Cash and cash equivalents:			
Beginning of year	$0	(193,550)	3,095
End of year	($193,550)	$3,095	$302,395

Income Statement--projected	Year 1	2	3
Sales	$2,350,000	$2,585,000	$2,839,500
Material	822,500	904,750	993,825
Labor	550,000	550,000	550,000
Lease	60,000	60,000	60,000
Advertising/Promotion	500,000	250,000	250,000
Tools depreciation	50,000	60,000	70,000
Cost of merchandise sold	1,932,500	1,764,750	1,853,825
Operating and Admin Expenses	100,000	100,000	100,000
Operating Profit	317,500	720,250	885,675
Other income (expense)			
Interest Income	0	0	93
Interest Expense	0	0	0
Shareholder related expense	(10,000)	(10,000)	(10,000)
Earnings before income taxes	307,500	710,250	875,768
Federal and state income taxes	(123,000)	(284,100)	(350,307)
Net earnings	$184,500	$426,150	$525,461

Quick Quiz:

1. How can you forecast sales? What information would you want to collect?
2. How would the financial statements be different for an EC firm (for example, a website that sells photographs)?
3. What key element would you place in the marketing section for a service firm (e.g., dentist)?

Reality Bytes: A Part Time Job as an Entrepreneur

Jay Brewer had worked as a Web designer at several startup companies. In 2001, he formed Blogpire, working on the site in his spare time. The site consists of a collection of blogs where people write opinions about consumer products that fall into specific niches. He began by writing reviews about single-serve coffee machines. The site took off and he started including ads from Google and Amazon. Within a month, Aloha Island Coffee agreed to advertise on the site. Mr. Brewer notes that "all of a sudden I had a little business. The site was making money from Google ads and Amazon, and it had its own direct advertiser." He moved on to launch three more blogs (kitchencontraptions.com, justthechips.com, and shavingstuff.com; all while continuing his day job. He noted that "you have to be disciplined and make a schedule and really get it going each day." By March 2005, his blogs kept increasing in traffic and revenue so he quit his regular job. His startup company created new blogs, hired writers, and brought on more direct advertisers. With 14 blogs, 750,000 visitors a month, and 30 direct advertisers he makes more money than at his previous jobs. The busiest sites can pull in $10,000 a month in revenue. Mr. Brewer noted that even with smaller volume, "this works because we are geared toward consumers that are looking to research something they want to buy. And for that reason, we get [a higher quality customer] than other sites, and that makes advertisers happy." His writers receive 50 percent of the revenue for a blog, and vendors now offer free products for review.

Adapted from Stephen Grocer, "Consumer-Product Blogs Spark a Web Empire," *The Wall Street Journal*, June 13, 2006.

Accounting and Benchmarks

Careful accounting is an important requirement in a start-up firm. You need to be particularly careful at tracking expenses. A good accounting system is important, but you must also establish procedures and policies. In the hectic day-to-day world of starting a firm, there is little time to stop and analyze every transaction. You need procedures in place so that everything gets recorded as soon as possible. If several managers have purchasing authority, a Web-based accounting system might be helpful to ensure that all items are recorded immediately—wherever the managers are located.

Your accounting system needs to run comparisons to benchmarks that you established in the business plan. For example, if your cash flow is running below projected levels, you will need to cut expenses or find additional funding. You need to closely monitor these numbers so that you have more time to react and make corrections.

If your firm requires developing software, you need to track the development progress. Estimating design and programming time is notoriously difficult, but you should still track the progress because you will need to update your target completion dates. Project management software shows how each task depends on others, and it can identify bottlenecks and highlight which tasks need additional resources.

The entrepreneur also needs to provide feedback to investors. Beyond standard quarterly accounting reports, you will need to keep investors apprised of development progress, marketing campaigns, and sales data.

Products	Services/Web 2.0

* Use simple HTML, Amazon, eBay or Web commerce server.
* Process payments through PayPal, Google, or similar third party.
* Hosted server is inexpensive today.
* Build links to get picked up by search engines.
	* Hosting: Use a hosted server or cloud computing.
	* Software Development
	  * Do you have the skills to hire, organize, and evaluate programmers?
	  * Will the code have to be updated and rewritten continually?
	  * Can the software be built using existing modules?

Figure 11.19

New businesses online. Many tools and companies make it straightforward to sell products online. In general, the hardest part will be the marketing—getting your site recognized. Building new online services or phone applications is more challenging. You will need to hire and pay developers and manage the development process.

Starting an e-Commerce Firm

What additional steps are required to start and EC firm? An EC start-up faces the same paperwork, financing, and organizational issues as any other firm. However, as shown in Figure 11.19, firms face additional tasks in terms of setting up the online elements. Today, these tasks are straightforward for selling products online. Chapter 7 explores the options in detail, but the simple answer is to pay someone else to run the servers and handle payments. The costs are relatively low and they are typically variable costs—perfect for startup companies. Most systems include scalability so it is easy to expand as traffic increases. Entrepreneurs are free to focus on the harder task: marketing.

Life is more challenging for new online businesses that want to develop service software, Web 2.0 social interactions, or mobile phone applications. To attract customers, these services need to be new and unique; which requires writing custom programs. Programming tools continue to improve, so programmers can be more efficient. However, the more unique the system, the harder it will be for others to copy, but it will be more difficult to create. A key element in creating new online services is the ability to hire, organize, and evaluate programmers. These topics are explored in Chapters 12 and 13.

Sites and services that have a social network component face another huge problem: attracting a large set of initial users. These types of services succeed only by attracting a large number of participants—known as the **network effect**. So, any newcomer must determine how to attract attention away from existing firms and find a way to encourage people to join its network instead. And it will take time to reach a critical threshold, so the firm must have funding sources that will carry it far enough to reach that point.

Reality Bytes: Pay Your DNS Bills

The Washington Post newspaper somehow missed renewing a payment on its domain name (WashPost.com). Because of the overdue bill, the domain name was delisted and readers, writers, and editors were unable to use the e-mail system that relies on the domain name. After identifying the cause, the newspaper quickly renewed the registration, and services were restored. The company was fortunate. Many of the domain registrars allow others to place a hold on a domain name that is not renewed. If you somehow do not renew a domain name, it could be immediately acquired by another company.

Adapted from Weiss, Todd R., "Overdue Domain Registration Bill Stops E-mail Access to Washington Post," *Computerworld*, February 6, 2004.

Analysis of Dot-Com Failures

Why did thousands of dot-com firms fail? This question first arose in 2001 and 2002. The question was important at that time because of an initial belief by many firms that it was possible to sell products online and survive without making a profit. The crash changed that belief—at least for a while. Then the interactive Web 2.0 came along and new firms were created. Once again, companies and investors believed that money could be made online even with no revenue. The two situations are different but have some similarities. It remains to be seen if social networking firms can survive in the long term. And the same question is likely to be raised in the future as new technologies are created.

From about 1996 to 2000, hundreds of dot-com firms were created, many in the San Francisco area. The excitement of the Internet led people to believe that these firms were the start of a new economy. Overhyped statements were made about the death of the old economy and that traditional bricks-and-mortar firms would soon fail, to be replaced by an online world of competitive prices and advertisements tailored to individual customers. Entrepreneurs believed that if they could be the first firm to break into a category, and if they advertised heavily enough, they would automatically become the dominant player in the new economy. Many investors felt it was important to get in on the ground floor of these firms. IPOs were released daily; stock prices soared. Newly minted paper billionaires graced the covers of business magazines. And then investors woke up and the market crashed. The NASDAQ market index that covered many of these technology firms dropped from over 5,000 points to around 2,000 in less than a year. Pundits whipsawed to the other end of the spectrum and proclaimed the end of e-commerce. Of course, reality lies between the two endpoints, but it is worth examining some of the concepts of the time to understand the role of e-commerce in the future.

Pure Internet Plays

One of the first types of firms to fail followed a strategy known as **pure Internet plays**, where the e-commerce firm relies entirely on Internet transactions for money—with no ties to real products. Examples include sites that provide services to other sites, such as the search engines and Web advertising sites. Closely related sites include some that advertised and sold products over the Internet, but relied on other traditional companies to produce and deliver the products to customers.

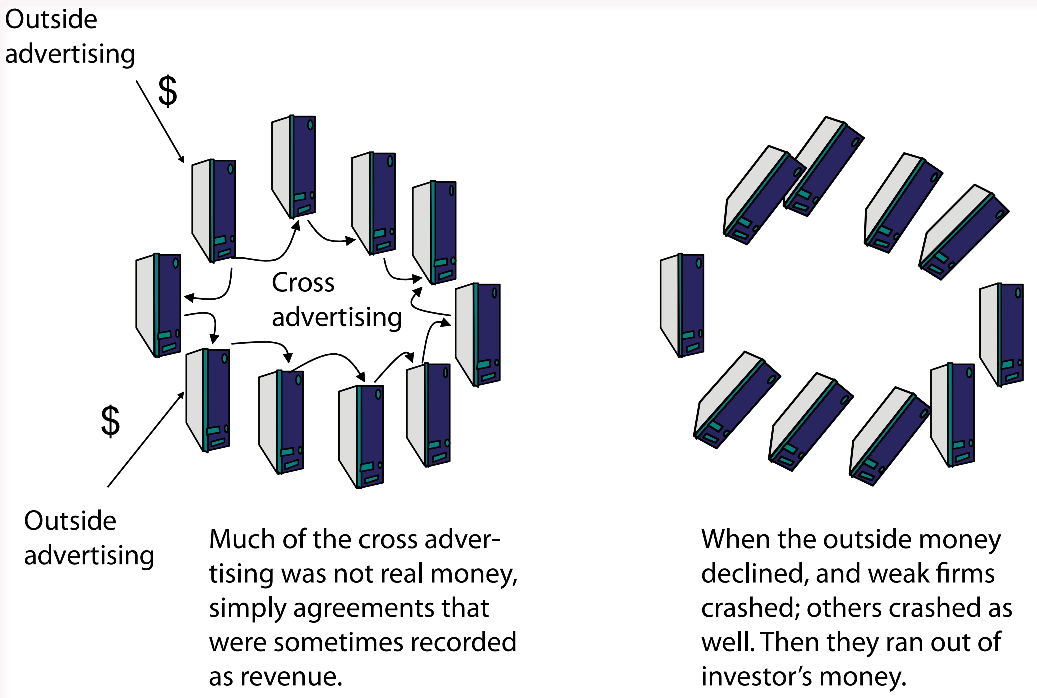


Figure 11.20

Dot-com advertising crash. Many of the early firms were linked by agreements to advertise on other sites. With few actual sales, some firms ran out of investor's money and the outside advertising money dried up. The weak firms crashed, which cut off the advertising money to others, and the domino effect accelerated the crash.

These firms were at risk because they depended almost completely on Internet traffic and funds. When a few of the firms failed, it set off a domino effect that reduced cash flow at many other firms. Many of the firms were interlocked with the others through service agreements and advertising relationships.

Profit Margins

Profit is an important issue for any firm. Yet many managers claimed that there was no need for traditional profits. This belief was endorsed by a market where IPOs were celebrated and stock prices on new firms jumped over $100 per share in the first day. These IPOs provided the cash that firms used to fund operations. In many cases, the goal of the firm was to advertise heavily and undercut prices in an attempt to build name recognition and capture market share. Even Amazon.com, one of the early entrants and cheerleader for e-commerce, gained its prominence by offering products at 30, 40, and 50 percent discounts. The CFO at Amazon once said that they never intended to make a profit. More recently, the firm has been working hard to reduce costs to achieve an operating profit. Much of the profit is the result of a change in strategy: substantially higher prices.

One of the challenges to measuring profits is that many different definitions of profit can be used, largely depending on which costs are included. But it is difficult to make a profit when products are sold for less than the cost of the item. It can be done, if additional revenue is received from other sources, such as advertising revenue, service contracts, or additional vendor payments. But, in the end, a firm must make a profit on operations or there is no point to continuing. In 2000, a McKinsey study revealed that only 20 percent of the e-commerce firms were making a profit on sales, and the top firms were actually traditional firms, such as mail-order companies.

Many of the early e-commerce firms attempted to establish market dominance through heavy advertising and large discounts. The plan was to use the name recognition to attract customers away from traditional firms and eventually increase prices to make a profit. The problem was that these firms still had to compete with traditional firms that already face considerable competition. In this crucible, the existing firms learned to squeeze costs. These efficiencies enable them to sell products at a profit and to fend off competitors during short-term attacks.

Advertising Revenue

As shown in Figure 11.20, Internet advertising revenue was a dominant factor in the failure of many of the early e-commerce firms. For some, the Internet appeared to be a new educational medium—much like television. Web sites would provide interesting or useful content that would attract viewers (often referred to as eyeballs). These sites would then sell screen space to other companies to use as advertising. The interactive nature of the Internet would also make it possible to track the effectiveness of the ads—both in terms of the number of times an ad was seen and in terms of the click-through rate for each ad.

This model does apply to some extent—the Interactive Advertising Board reported that U.S. Internet advertising revenue was $8.2 billion in 2000. However, only a handful of the top firms receive the lion's share of the revenue. Moreover, as click-through rates fell in 2000, advertisers began to believe that browsers no longer paid attention to the ads, so they began to question the value of advertising on the Internet and became particularly leery of smaller sites.

The situation was compounded by the fact that many of the firms followed some shaky accounting practices. For instance, advertising exchange agreements were often counted as revenue. Firm A would agree to carry advertisements for firm B in exchange for similar ads on B's site. Both sites recorded revenue from the advertisements—but never received any cash.

With the declining emphasis on advertising revenue, content providers are increasing their attempts to charge consumers for the content. According to a study by Jupiter Media Metrix, one of the leading e-commerce monitoring firms, in 1999 the top 100 firms were charging for only 6 percent of their content. In 2000, that number almost doubled to 11 percent. Almost all of these firms anticipate charging for some content by 2003. Some of the content is paid with service agreements, some through micro-payments for individual pieces of data.

The online world changed considerably—partly from the early crash, but also because of Google. Remember that Google controls most of the online advertising—but it enables any Web site to participate. One of the positive effects of this control is that online advertising money is real and not just an accounting entry. Still, more firms exist as purely online today. Between social networks, news sites, and dozens of other types of service-oriented sites, thousands of Web sites depend almost completely on advertising revenue. Others, particularly Twitter, have yet to find a mechanism to generate significant amounts of revenue. Yet, investors are putting huge amounts of money into some of these firms; so they must believe that the companies can eventually be profitable. It is difficult for outsiders to evaluate the situation when the firms remain private and do not publish financial data.

News sites are an interesting example of the challenges. As the traditional newspapers lose print circulation, they are searching for new ways to survive. For several years, most newspapers offered online content free (except the Wall Street Journal). In 2011, led by experiments by a few smaller papers, the New York Times began charging for some content. The risk is that with free content elsewhere, users will simply disappear instead of paying. So the paper could lose advertising revenue because of a smaller number of readers. Selecting a revenue method is still a difficult problem for online sites.

Cloud Computing

How does cloud computing help startup firms? One of the main strengths of cloud computing is that it is designed to price technology as a variable cost. Firms can establish servers and Web sites with no fixed costs. These sites can be scaled to almost any size—simply by paying more fees as the usage rates increase. Cloud computing makes it easy for a startup firm to obtain any level of computing. Firms still need to purchase personal computers, but these can be relatively inexpensive. At the extreme end, today a company can run all software online, including standard word processing and accounting systems. Even firms with dozens or hundreds of employees could follow this approach. The personal computers would just run browsers and would essentially be disposable. All software and data can be stored online. Technical support, upgrades, security, and most other tasks would be handled by the online providers. The amazing part is that the costs are all variable, and the firm does not need to come up with large sums of money up front. As the company grows, more capacity is added and the costs increase—but presumably, the increased business revenue will cover the new costs.

In less extreme cases, some companies will still have to purchase and run computers. For example, a simple restaurant will likely need a turnkey computer system. However, even in these cases, most of the elements can be leased by paying a monthly fee. And technical support is provided by the company that created and installed the system. The cloud can be used in these situations to provide backup and access to the data for external owners and managers.

Many firms might want to run their own transaction systems. In these cases, cloud computing is useful for higher-level tasks such as teamwork and data analysis. Tools for meetings, sharing data, and even some data analysis and expert systems can be run as cloud services. Some enterprise features such as customer-relationship management are also readily available online. The point is that entrepreneurs can find many levels of tools in the cloud and pay for them as they need them. This availability makes it possible for companies to compete at a much higher level than in the past.

Summary

Small businesses need information systems as much as any company. However, small businesses face constraints on money, limited number of workers, lack of IT expertise, and strategic power. Many small businesses look at IT as a back-office expense that is a necessary evil but rarely contributes to making money. Consequently, many small businesses under invest in information technology. With declining technology costs and increasing options through online services, more opportunities exist to use IT to reduce costs and improve productivity.

Small businesses, particularly startups, need to focus on using IT for transaction processing and day-to-day operations. Most will use basic accounting systems to record financial information. Small businesses should increasingly look at online ERP services to provide more sophisticated tools with minimal effort and fixed monthly fees. Beyond choosing an accounting system, managers need to focus on the type of data and information they want to extract from the transaction system. HRM systems are complex because of the constantly changing local, state, and federal laws. Consequently, most businesses pay a service to handle payroll and other HRM transactions.

Entrepreneurship requires a good idea and a detailed plan, followed by implementation. The plan should include financial details and budgets. You then have to raise the money needed to start the business and keep it operational until it generates sufficient revenue to be self-sustaining. Developing online e-businesses can be straightforward if you just need to sell products. Developing new systems with completely new software is far more complex and requires the ability to manage development projects.

A Manager's View

Small businesses face the same decisions and technology issues as large companies. But they have fewer workers, less money, and less expertise. Information technology can provide many benefits including reduced costs and improved productivity. However, all technology has to be evaluated carefully. Hiring MIS workers is an expensive fixed cost, so small businesses will often want to examine turn-key and online service firms instead of trying to run in-house technology. Creating a plan and successfully implementing it are critical steps in entrepreneurship and e-business firms.

Key Words

CAN-SPAM Act
entrepreneurship
initial public offering (IPO)
limited liability company (LLC)
network effect
pure Internet plays
stock options
subchapter S corporation
turn-key systems
venture capital (VC)

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Common Statistics	
Bureau of Labor Statistics	www.bls.gov
Census Bureau	www.census.gov
FedStats	www.fedstats.gov
General Reference Sites	
Library of Congress	thomas.loc.gov
Congress	www.house.gov www.senate.gov
Congressional Quarterly	www.cq.com
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IRS	www.irs.gov
Judicial	www.uscourts.gov
Legislative votes	www.vis.org/toolbox/default.aspx
Patent Office	www.uspto.gov

Review Questions

1. What are the primary constraints facing small businesses?
2. How can small businesses deal with a lack of IT expertise?
3. How do most small businesses acquire IT to handle operations?
4. How could small businesses use affordable technology better at the tactical level?
5. What are the benefits to designing an accounting system while you are planning a new business?
6. How can IT be used to help start a business or find opportunities?
7. How do the elements of strategic analysis relate to entrepreneurship?
8. What are the main choices for firm structure and financing?
9. What additional steps are needed to start an EC firm?
10. Why did so many dot-com firms fail in 2000/2001 and is it likely to happen again?

Exercises

1. Consider a small service firm such as a physician, dentist, accountant, or lawyer. Is it possible for such an office to use computers to gain a competitive advantage? To start, identify the customers, suppliers, and rivals. Do you think the "natural" switching costs are high or low; that is, how often do customers switch to competitors? Which of the major techniques do you think would be the most successful (barriers to entry, switching costs, quality control, lower prices, ties to customers or suppliers, etc.)?
2. Write a business plan for a new company. Choose an existing small company if you do not have ideas for a new firm.
3. Research the detailed steps needed to start a Chapter S corporation in your state. Obtain the necessary forms (most states have them on Web sites).
4. Visit a small business or talk to an owner/manager (perhaps a relative). Identify the use of information technology and write a short report on how the firm could benefit from using additional technology, particularly for decision making and collaboration.
5. If you were starting a new restaurant, would you choose a franchise or start an independent operation? Explain why.
6. Interview a manager of a small business (< 500 employees), possibly a friend or relative. Identify the use of information technology in the three decision levels (operations, tactics, and strategies). Just ask about IT, do not expect the manager to be able to classify the technology for you. Who does the manager use for IT advice and support? How many MIS employees are there? Where does the manager believe the company lies on the levels of technology (leading edge, turn-key, bare-bones)? Where would you classify the company?

7. How long would it take you to build a spreadsheet/Access application that could be used to forecast a daily count of customers at a small restaurant? If you could sell the application, you much do you think you could charge? Now search the Internet to see if such an application exists.
8. If you (or a friend) want to create a new smart phone application but do not know how to program, how will you find a programmer or two and how much will it cost? Why would a programmer work for you instead of creating the application independently?
9. Search the Web and find a site or tool that will help you create a business plan. What features could this tool provide that would be helpful?
10. Assume you want to run a Web site that survives on advertising revenue. Estimate how much money Google pays for advertising clicks and the number of visitors per month you would need to generate $1,000.

Technology Toolbox

11. Collect several commercial e-mail messages and count the number of violations of the CAN-SPAM Act provisions.
12. What provisions could you add to the Act that might actually reduce the level of unwanted messages?
13. If spammers violate all of the provisions of the Act, how can you track them down?
14. Select a small business that you might want to start. Choose the type of business structure and where it will be located. Explain your choices.
15. Choose a company that you would like to start, write the overall strategy section, and build the projected accounting statements for the first three years.
16. Assume that you have been hired by a physician who wants to start a Web site to help dieters. Create a business plan that focuses on the competition, marketing, and Web aspects of the business.

Teamwork

17. Choose a firm that the team might want to start. Create a brief business plan for the company by assigning one section to each team member.
18. Assign each person to investigate a different accounting system, including online, that could be used for a small business. Write a report that compares the features, costs, and limitations of each package. If possible, recommend one for someone with a small business.
19. Select an industry that has several many small businesses such as restaurants (or have one assigned by your instructor). Find at least two turn-key systems that are available for businesses in this industry. Without harassing sales representatives, compare the systems in terms of features, price, and market share. If possible, talk to a small business owner who uses the system for additional comments.

20. Find at least two companies that process payrolls for small companies. Compare their features, and if possible, market share and prices.
21. Construct an e-mail ad that meets the CAN-SPAM criteria. Send the ad to each other and see if it makes it through the anti-spam filters. Try using a non-university e-mail account. Report on the results.
22. Find at least two systems that could be used to run a restaurant of about 60 tables. Determine the number of terminals that would be needed. Compare the two systems in terms of features, and select the better system.

Rolling Thunder Database

23. Using the existing data, write a business plan to obtain venture capital to expand the operations of Rolling Thunder—focusing on the need to develop a marketing campaign and a Web-based ordering system.
24. Outline a plan to develop and create an e-commerce site for Rolling Thunder Bicycles. Estimate the costs to develop and host the site.
25. Assuming the salaries and capital costs are fixed to start Rolling Thunder Bicycles, and assuming the average price of a bicycle is $2,250, compute the break-even number of bicycles.
26. Describe the level of technology that would be appropriate for Rolling Thunder Bicycles as a startup. What would be an approximate budget?
27. Can the company justify hiring a full-time MIS employee? If not, how should the MIS tasks be handled?

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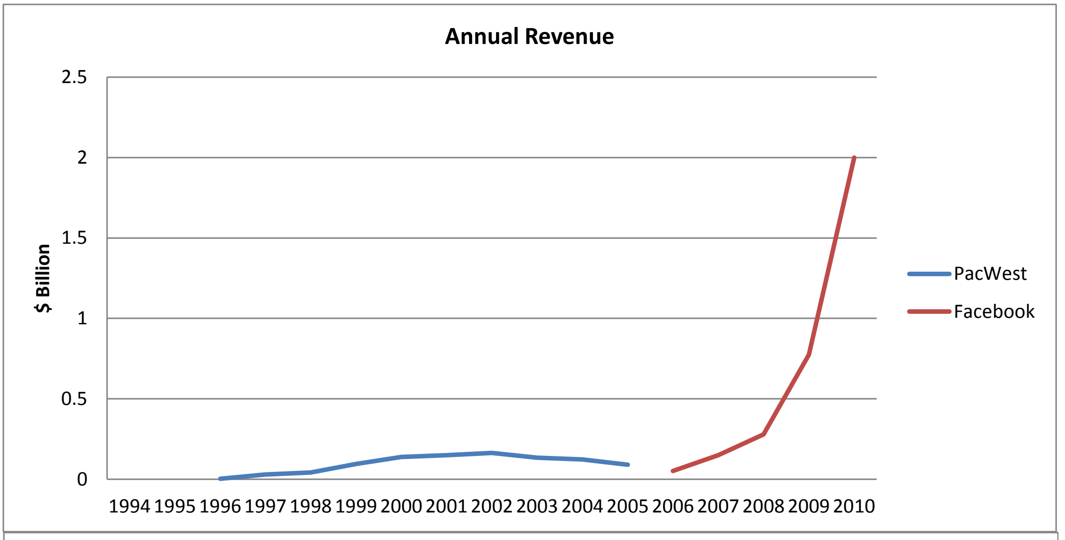
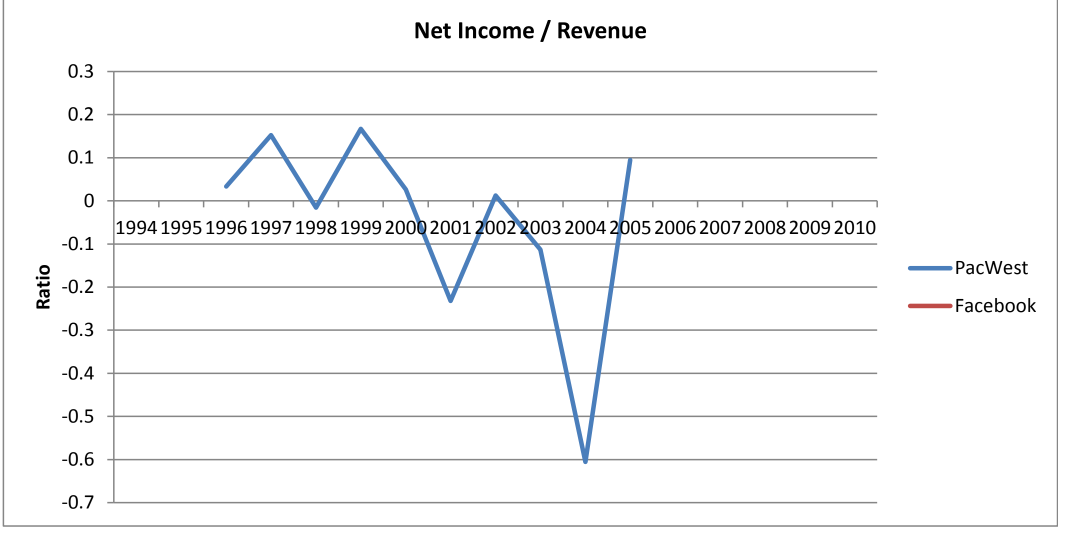
Cases: Entrepreneurship

The Industry





Entrepreneurship is the practice of starting a new business. The business might start small with one or two employees, become a large corporation, or anywhere in between. In many ways, the American economy has been driven by entrepreneurs, people with vision and independence, willing to take risks and try new ideas and new technologies. But starting a business requires more than just ideas and enthusiasm. It requires detailed organizational skills. The entrepreneur is responsible for creating all of the many procedures and rules that will keep the business running. You have to determine simple things like how the daily receipts get deposited each day and how employees are evaluated. You also have to determine all of the big-picture issues, such as the best way to counter a new plan by a competitor and keeping your customers happy. Several familiar companies began as small firms and grew to dominate their respective industries and even the economy. The large computer firms of IBM and Hewlett-Packard were once small companies. The Edward Jones brokerage firm was started by one man.

In 2000, slightly over 5 million corporations filed income tax returns in the United States, along with about 2 million partnerships and almost 18 million proprietorships. About 12 million of those proprietorships had less than $25,000 in receipts, compared to 1.2 million of the corporations and 1.1 million partnerships. Most of the corporations had receipts between $100,000 and $500,000. The total number of corporations increased from 3.7 million in 1990 to 5.0 million in 2000. At the same time, partnerships increased from 1.5 million to 2.1 million and proprietorships from 14.8 million to 17.9 million. The actual number of new firms created will be higher because the totals do not count the firms that disappeared in that time. Looking only at 1999 to 2000 (the most recent data available), the number of all firms increased by 559,000 (a 2.2 percent increase) (U.S. Census Bureau 2002).

The Internet

The Internet raises the hopes of many of today's entrepreneurs. You can use it to reach a large audience—perhaps even worldwide. You can start small with a limited budget. But as the dot-com crash of the early 2000s shows, you still need a business plan. You need an idea that will generate profits. Even small expenses can overwhelm a company that has no sales revenue. People are still drawn by the examples of companies like Amazon.com, Yahoo, and Google. Of course, many forget about the hundreds of other Web start-ups that failed. Some of those companies actually had good ideas and plans. Part of their failure was due to timing—entrepreneurs and investors thought the world could be changed overnight.

Financing

Starting a business requires money—start-up capital. Depending on the industry, you might need to purchase buildings or equipment. You might have to pay programmers to develop software. You generally have to rent an office and rent or buy furniture. You most likely need to buy computers, along with office supplies. You might have to pay for licenses or patent fees. You most likely need to pay employees until the business generates enough cash to cover the day-to-day expenses. Several sources of funding exist, but most of of them have drawbacks. If you can get by with small amounts of money, the best answer would be to save it and invest yourself, or with family members. Larger amounts of capital can be obtained from angel investors or possibly venture capital firms. Sometimes you can borrow money from a bank, but those amounts are generally limited to specific items such as inventory or capital goods that can be resold if your company fails to survive. No one gives you money for free. Banks require you to pay interest. Venture capital firms often ask you to give up some control, and they install a manager. In most cases, you give up some ownership, as the investors gain a negotiated percentage of your company.

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Case: Petz Enterprises Inc. (TaxBrain)

Leroy E. Petz, Sr., founded Petz Enterprises in 1964 in Tracy, California. Until 2000, the company specialized in providing tax software for accounting firms. The CrossLink package was commonly used by accountants to complete and print income tax returns for clients. The accounting firms, or local tax offices, buy the software annually and then use it to produce even complex returns for customers. The accountants provide advice and organize the customer's data. Clients often arrive with a shoebox full of receipts and the accountant has to sort it and categorize the data to determine what items are deductible and classify the income properly.

In 2000, the company realized that the Internet was going to become an important method for individuals to file taxes. The company created the TaxBrain Web site using its knowledge of the tax laws (company Web site).

CrossLink

As its original flagship product, CrossLink is an important source of revenue and name recognition. Petz has continued to improve the product over time to make it easier to use and to provide features that are useful to large tax-preparation offices. For example, returns that are filed electronically are initially evaluated by the IRS. If there are errors, the CrossLink package picks up the messages and integrates them into the form so that the tax preparer can quickly see the problems with a complete diagnostic statement. In 2001, the company also added the Tax Return Logging System. Petz notes that "tax offices with branches need to keep track of all tax returns. The Tax Return Logging System will track all returns that have been created, deleted, and changed" (McCausland and Lombardo 2001). The potential problem is that in a large company, a tax preparer hired in a remote location might use the software to generate a client's return, print it, and pocket the money. With the logging system, all use of the system is tracked.

In 2003, Petz rolled out a new approach—hosting the tax preparation software on its own site. Charles Petz, product development director, notes that the new product (VTax) "is a subset of our professional [CrossLink] product, but we're going after guys who have a lot of offices" ("Petz Enterprises" 2003). In particular, the system is geared for the hundreds of neighborhood electronic refund originators (EROs) that have sprung up in the past couple of years. The companies set up small storefront operations, and customers show up with their W2 form and basic financial information. Clerks enter the data into the system and give the clients an immediate refund. Of course, the refund is really a short-term loan and the actual refund is collected by the ERO, minus the interest and filing costs. The key is that the ERO practitioner has all of the data up-front to make the loan and can file the data immediately or hold it until later if additional information is needed. By using a hosted service, the ERO office needs only a simple computer with a Web browser and a basic Internet connection. Even better, all offices of the ERO have access to the form. A client could drop off paperwork at one site and return to a different one if needed. The system also prints detailed reports of activity by office. Originally, Petz anticipated 500 to 600 offices using the system. In the end, "it looks like we'll be closer to 2,000 locations," through 10 different EROs ("Petz Enterprises" 2003). Another strength of the hosted service is that the ERO can quickly set up a new office if demand is high. V-Tax appeared to appeal to practitioners because of its ease of use and the ability to open new service offices with just a Web browser and an Internet connection. (Widmer 2007 and Accounting Technology 2006).

In 2010, Petz continued to expand the CrossLink professional suite. The company opened offices in Bellevue, WA and Rome, GA to help support the product and extend coverage nationwide.

TaxBrain.com

In 2000 and 2001, the TaxBrain site saw limited commercial success. For a flat fee of $24.95, individuals could file federal and state returns. The electronic filing fee was included in the cost. By filing electronically, filers could get a refund in as little as 10 days. Since they did not have to buy and install software, customers needed little computer knowledge. Mr. Petz noted that although the company did only limited marketing, “we saw over 10,000 hits a day and we have no idea how people found us” (McCausland and Lombardo 2001).

In 2002, Petz got more serious about the TaxBrain site. The company completely reworked the user interface to make it easier to use. It also began a more targeted marketing campaign to bring in more users and track where they were coming from. In November 2002, Petz observed that in the 2000 tax year, 130 million individual tax returns were filed, with 17.7 percent of those from off-the-shelf software. By 2005, he forecasted that percentage to drop to 7.1 percent. In 2000, 56.7 percent of individuals paid a professional to file their forms; his forecasts show that by 2005 that number will drop to 48 percent (press release 2002).

By 2003, the site was the third most popular tax system on the Internet, behind only the giants H&R Block and Intuit (TurboTax). At its peak on April 15, 2003, TaxBrain attracted 50,000 unique visitors (press release May 2003).

At the same time, the IRS saw a huge increase in the number of people filing returns electronically, with 53 million filed electronically in 2003 (IRS Web site). Leroy Petz Sr. explains the popularity, “For millions of Americans, filing over the Internet is now accepted as the best way to go to beat the deadline. TaxBrain can help you get your taxes filed in less than an hour, provides assistance through live instant messaging chat and ensures your return is ‘received’ by the IRS with an official electronic reply.” Petz also estimates that individuals “are saving more than $200 in time and professional fees doing their returns online” (“TaxBrain” 2004). Electronic filing is also better at catching errors, particularly since the IRS system catches most common problems and identifies them immediately. Overall, about 20 percent of paper returns have errors, while less than 1 percent of electronic returns have errors.

Although electronic filing is increasing, much of the growth is through third-party systems, such as the local offices and purchased software. For 2004, Petz initiated a larger marketing campaign. Leroy Petz, Sr., notes that “in order to make people more aware that they can prepare and file their taxes online, PEI is embarking on an aggressive media campaign to inform taxpayers of the ease, speed, and security of doing their taxes with TaxBrain. Our biggest challenge is demonstrating to the taxpaying public that it is truly easy” (press release December 2003).

Because of the company’s background in writing software for professionals, TaxBrain benefits by being up to date. Online reviews, such as http://tax-software-review.toptenreviews.com/tax-brain-review.html, have pointed out the software for being accurate and up to date. They have also recognized the telephone and chat support availability. Although, the company suffered in 2009 when a wrong bank routing number was used and direct-deposit refunds were delayed for many customers.

Free Filing

Given the new IRS emphasis on electronic filing, along with the automated reporting system by employers and banks, many Americans are beginning to raise an important question: Why do they have to pay to purchase software or file electronically? Why not let the IRS develop the online software and make it available for free? To expert observers, the most immediate answer to the question is that the IRS has historically been terrible at developing software. The second issue is that the IRS might be tempted to provide tax advice. Although it might seem strange, many people could be better off using private advice instead of recommendations from the IRS. The IRS is likely to be considerably more conservative and has been known to ignore court cases that it has lost (Becker 2002). But over time, there is a possibility that the IRS could compete with the commercial providers.

In part to answer these questions, several of the commercial providers cooperated with the IRS in 2003 to offer the IRS Free Filing Program. The goal was to target the low-income and elderly populations. TaxBrain participated in 2003 and served 50,000 individuals. Strangely, in 2004, the IRS created a new rule that required all commercial providers to permanently flag every return that was filed through the program. The IRS apparently wanted to perform some type of analysis on these returns, but did not disclose the reasoning. Consequently, TaxBrain decided not to participate in the program—believing that it as an unnecessary invasion of privacy with a high risk to individuals (press release 2004). TurboTax announced that it would continue to participate, but would ignore the IRS requirements and not flag the returns of those participating in the program (Wiles 2004). The IRS denied that taxpayer privacy might be compromised, but failed to provide an explanation. The IRS does note that it has always been able to tell how a return was prepared, whether it was by software, volunteer, or IRS walk-in location (Wiles 2004).

In 2005, about 13 million taxpayers filed tax returns over the Internet. The number was expected to continue growing at double-digit rates (Keizer 2006). For 2007 (2006 tax year), Petz handled almost 38 million individual tax returns, and 30 million of those used e-filing. Of those that were filed electronically, 21 million were handled through tax professionals (CrossLink and V-Tax), and 9 million were self-prepared through TaxBrain (Petz Newsletter March 2007).

Questions

1. How can TaxBrain gain more customers and take market share from H&R Block and Intuit?
2. How does the CrossLink system give Petz an advantage with the TaxBrain site?
3. Should the IRS develop online tax software, possibly eliminating firms like H&R Block, Intuit, and Petz Enterprises?
4. By 2010, what percentage of people will file tax returns electronically? When this maximum is reached, how will Petz continue to grow?
5. Did Petz make the right decision with the Free File program? Should the company rejoin it?

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Case: Pac-West Telecomm, Inc.

Located in Stockton, California, Pac-West Telecomm (ticker: PACW) was founded in 1980 by Wally Griffin. The company is a competitive local exchange carrier (CLEC), which is a technical description for a telephone company that is not one of the original Bell companies. With the breakup of the telephone monopoly in 1986, the way was cleared for new firms to step in and provide voice and data services. Of course, it would be incredibly expensive to provide service to individuals, so the company focuses on communications for businesses. In particular, Pac-West dominates in providing data connections for Internet service providers and call centers. The company can provide one-stop service for all telecommunication needs, including voice and data (company Web site).

Internet Service Providers

Perhaps the most interesting service provided by Pac-West is its extensive telecommunications for West Coast ISPs. If you have a dial-up Internet account, you have to call a point-of-presence (POP) phone number. This number connects your modem to another modem, which is connected to a router and gets you on the Internet. But where is that modem and router located? One solution might be to put banks of modems in many cities and then connect them together. But that approach would require high-speed Internet lines in hundreds or thousands of locations even in small cities. Remember that most people want to dial local phone numbers to connect to the Internet. The solution Pac-West offers is to place telephone switches in these multiple areas. You dial that local phone, the switch transfers the call to one of Pac-West's SuperPOPs, which then connects to the Internet. Costs are reduced by consolidating the POP connections to a few locations. Reliability is higher because it is easier to provide multiple modems and backup facilities in the limited number of SuperPOPs.

Pac-West does not sell individual Internet connections. Instead, ISPs contract to use Pac-West's network. In 2000, over 90 ISPs were using the system, including Earthlink and NetZero (press release May 2000). The company had $95 million in revenue in 1999, followed by $139 million in 2000 (annual report). For the most part, Pac-West leases high-speed lines in bulk, and then resells services to smaller firms. For example, in 2000, the company signed with Qwest for exclusive rights to an OC-48 optical transport ring from central to southern California. The line provides speeds of 2.4 gigabits per second ("Qwest" 2000). Jason Mills, vice president of network operations for Pac-West, notes that "ISPs and corporations need to focus on their core business, not building, financing and administering a widely distributed access network" (Alcatel).

In 2003 and 2004, several firms introduced data compression technology to reduce the time it takes to transfer data on dial-up lines. Pac-West installed this equipment on its servers and made it available to its ISP clients. With virtually no additional effort or change in technology, the ISPs could now offer faster access to individual customers. Wayne Bell, Pac-West's vice president of marketing and sales, observed: "The content acceleration technologies that are available through our partner program offer dial-up subscribers an Internet experience up to 5x faster than traditional dial-up, including Web surfing, file downloads, and email, at a fraction of the cost of broadband alternatives, such as DSL, cable, and wireless. By partnering with our ISP customers to enhance their dial-up service, we help them improve customer satisfaction, reduce churn, and generate new revenue streams, particularly in areas where DSL, cable, and wireless are not available" (press release 2004).

In the mid-2000s, Pac-West needed to find a product that could support growth. Voice over IP (VoIP) was one answer that made sense. Pac-West has solid Internet connections as well as direct ties into the publicly-switched telephone network. It is relatively easy for customers with broadband connections to install a VoIP telephone. And if you are simply calling another user with a VoIP phone, the entire connection can be handled over the Internet. However, to call standard telephones or cell phones, the Internet call has to be moved onto the telephone lines. Pac-West became a wholesale provider for handling these connections. Sarita Fernandes, VP of marketing and product management in 2007 said that "we are still seeing a lot of people getting into VoIP space" (Wilson 2007). In 2005, Pac-West sold its traditional business telephone clients, along with some supporting equipment, to U.S. TelePacific Corp. (2006 Annual Report). With the sale, Pac-West was able to show a net income of $8.5 million in 2005.

Growth and the Telecommunications Crash

In 2001 and 2002, the telecommunications industry suffered a major collapse. In part, the crash was driven by the dot-com Internet crash. As firms failed, payments to Internet providers declined. But a big part of the telecommunications crash happened in the network side, when several large firms filed for bankruptcy. The problem was that they had overbuilt capacity. Anticipating huge and continued Internet expansion, some firms borrowed heavily to lay thousands of miles of fiber optic cables. When demand never materialized, they filed for bankruptcy. Pac-West avoided this fate. In 2002, Griffin noted that "we stayed out of fiber. We're not digging any holes in the ground. That's what kept us at a lower debt rating." Even so, with sales of $150 million in 2002, Pac-West lost $34.7 million ("Pac-West Telecomm" 2002).

Despite the challenges, Pac-West is still a substantial presence in the West Coast states. In 2004, Pac-West reported that it carries about 20 percent of the dial-up Internet traffic in California. It also carries over 120 million minutes of voice and data traffic per day (company Web site).

The Role of the FCC

The Federal Communications Commission (FCC) both through policy and through losing some court cases has caused some consternation among the CLECs. One FCC order phases out the line sharing policy that was imposed on the local telephone monopolies. These companies were originally required to offer a choice of ISPs to DSL subscribers. If you wanted a high-speed line, you had to pay the phone monopoly to handle the communication over the copper wire from your house to a switching facility. But you had a choice of using the phone company as the ISP to connect to the Internet or a third company. Dropping this rule most likely will result in less competition and possibly higher prices for DSL services (press release May 2003). If prices for DSL do increase, demand for higher-speed dial-up connections is likely to increase. So, Pac-West could benefit.

The other major shift in policy occurred when the U.S. Solicitor General refused to seek Supreme Court review of an FCC order that was overturned in a federal court. The original order gave the FCC the power to regulate prices for unbundled network elements (UNEs) from the local phone monopolies. The original monopoly breakup decree required that the phone companies lease lines and physical space to other companies so that they could connect to individual phone lines and offer new services. The FCC order enabled the agency to control the pricing for these leases. Since the order was overturned, the monopoly phone companies are now free to charge any price they choose. These increased costs have the potential to put rival CLECs out of business. However, John Sumpter, Pac-West's vice president of regulatory, notes that "Pac-West does not employ UNEs in its current network architecture in any significant way, and therefore is not directly impacted by these actions." But he also gets a nice jab in at the same time: "Indirectly, however, perpetual regulatory confusion and biased decision making in favor of the former monopolies continue to impede the benefits of competition intended by the 1996 Telecom Act" (PRNewsWire 2004).

Investors

A company the size of Pac-West requires decent capitalization. Pac-West was a "closely held" company, which means it had only a few key stockholder investors. In 1998, an investment group led by Safeguard Scientifics acquired Pac-West for $115 million. The infusion of cash was primarily used to pay for expansions ("Technology Brief" 1998). Most of the money was provided by venture capital firms: Bay Alarm Co., SCP Private Equity Partners, William Blair Capital Partners, and TL Ventures.

In 2000, at the height of the Internet bubble, the group took Pac-West public with an initial public offering (IPO). The offering raised about $106 million, primarily targeted for capital expenditures and working capital (Postelnicu 2000). The company had profits of $3.6 million on revenues of $139 million in 2000. Although revenues increased in 2001 and 2002, the company suffered $34.8 million in losses in 2001. It recovered slightly to a $2 million profit in 2002. In 2003, the company downsized to reduce costs, and revenue plunged by almost 18 percent to $134.6 million with a net loss of $15 million (Corporate annual report).

Adjusted for splits, Pac-West's stock price peaked at $40 a share early in 2000. Suffering from the dot-com crash and then the telecommunication industry meltdown, the stock plunged in 2001 and 2002. In 2003, the company was almost delisted from NASDAQ when its price fell below $1 per share. The company had planned a reverse stock split in 2003 to increase the price of its stock, but in August, the stock price had recovered sufficiently to meet the listing criteria (press release August 2003).

On April 30, 2007, Pac-West filed for Chapter 11 bankruptcy and most of the senior managers resigned (8-K SEC filed on May 1, 2007). The company planned to continue its national expansion into the VoIP market in cooperation with Verisign.

Pac-West became a private company after bankruptcy. In 2008, it acquired Tex-Link Communications, a firm that provided similar services in Texas. Pac-West also reported that it carried 20 percent of the California Internet dial-up traffic in 2010 (Web site). In 2010, Pac-West introduced the Telastic service to provide cloud-based telecommunications. Essentially, Pac-West runs Internet server-based tools to handle VoIP services. Pac-West provides the services to ISPs and smaller phone companies.

Questions

1. Can Pac-West survive? What will the company need to do to grow?
2. Since the industry is heavily regulated, what can the government do to encourage growth in firms like Pac-West? Should this growth be encouraged?
3. What ongoing information technology events will affect the growth and survival of Pac-West?
4. Can Pac-West make better use of information technology or the Internet to improve sales or reduce costs?

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Case: Facebook

As a company with 500 million active users and over 2,000 employees in 2010, Facebook no longer seems like a startup company. Yet the company was only founded in 2004 and represents a classic case of successful entrepreneurship. Some of the startup aspects of the company were accentuated in the popular movie *The Social Network*, which presented a loose and somewhat fictional background of the company's early days. Also, because of the controversy at the startup and the lengthy lawsuits, a considerable amount of "information" regarding startup details and communications have been made public (Carlson 2010). For those who missed the movie, book, and extended lawsuits, essentially, two other Harvard students (the Winklevoss twins), have stated that they initially hired Mark Zuckerberg to create a site for them and that Zuckerberg "stole" their ideas and turned them into Facebook. At one point, Facebook paid them $65 million. Which probably would have been enough money for most people, but then they argued that Facebook withheld critical valuation data and they thought they should have more money. The case and appeals dragged through the courts for years, but Facebook continued to win. In the end, the political details are probably unimportant to the business aspects of the company. However, they do highlight some of the concerns any startup company must face. Any idea for a company is rarely completely new or isolated. It is always easy for someone to claim that they had an idea first. Even though it might be difficult to prove in court, the legal fees can become an issue. In fact, Facebook was not the first social network on the Internet.

Two other issues are more interesting in the case of Facebook: (1) How Facebook can make money, and (2) Shareholders and investing. The two topics are closely related. If a company is not making money, it needs early investors to pump in money in the hopes that someday it will generate revenue. Most startup companies need to focus on revenue early in the discussions. Eventually, no firm can survive without revenue and profits. The challenge for Web-based firms is that two streams of revenue exist: Sales and Advertising. Both of them present challenges to firms like Facebook that need to attract a large number of users.

A network site can succeed only if it has a huge numbers of users. Who wants to belong to a network with a small number of users? But, then how does a network get started? In Facebook's case, the answer was to start the network as exclusive—to Harvard, then other top-tier universities. At any one school, it was easier to entice a small number of students to join the site. As the company spread into more schools, it then had a base of users that appealed to more schools and could spread nationwide. For the first few years, only students at universities (based on their e-mail addresses) could join Facebook. By the time Facebook opened the network to anyone (September 2006), it already had a large base of users. This strong base of young adults gave a strong reputation to the company. People who belonged to earlier sites (such as MySpace and Friendster), jumped ship and signed up on Facebook.

Consider social networks from the perspective as a user for a minute. How would you choose a network site? Do the features matter? Speed? Or just the number of friends you have on the network? Now, what happens if a new site is developed and a bunch of your friends move to that site. Would you change? If so, when? Would you be an early adopter or wait until many people have switched? How hard would it be to switch? Now, look at Facebook's "policy" that makes it difficult (or perhaps impossible) to automatically transfer your collection of e-mail addresses and other data to a different site (Sullivan 2010). OK, you can transfer the data but you have to do it by hand. Facebook prevents anyone from building an automated tool to pull your data and transfer it to a competitor. But, how "bad" would a site have to be, or how "good" would a new site have to be for you to consider changing?

For example, Facebook has had several episodes of problems with privacy. Over time, the company has been trying to add more privacy features and to give users more control over who sees their data. But, partly because the features appear to have been added on, instead of built in at the start, they tend to be difficult to use. In mid-2011, Google introduced a new social networking service that included easer and better privacy controls (Miller 2011). But, will it be enough for people to switch? Once people do start switching away from a network, a point is reached where the first network quickly collapses (see MySpace or Friendster).

Now, go back and think again about the issue of money. If you plan to be an entrepreneur, you should always remember the money issue. If a company charges fees to use a social network (mostly at dating sites), the fee automatically restricts the number of users. Some fees might be low enough to be unimportant, but the network will have slower growth if fees are charged. A secondary possibility is to charge fees for "premium" items, such as added storage space or customization. But any base fee runs the risk of driving users to competitor sites.

The other way of raising money is to sell advertising, which is about the only way social networks can realistically make money. First, the site has to be large enough to attract big advertisers. More people on the site mean more advertising money available. But, the site needs some way to display ads; and the people using the site have to not only tolerate the ads, but actually click on enough of them and perhaps buy something from the advertisers, or the advertisers will stop. If the site relies on the big sites such as Google to provide the ads, then it will collect only a minor share of the advertising money. So, ultimately, the site has to sell its own advertising, which means it needs the software to display and track the ads, and the company needs a sales staff to find advertisers. If you look at Facebook's Web site of press releases it shows offices in at least nine U.S. cities and 14 other cities around the world. Most of the people in these offices are probably dedicated to selling ads, or the accounting associated with them. Advertising revenue in 2010 was stated to be $1.86 billion, with some additional revenue for on-site sales yielding about $2 billion in total revenue. Eventually, the actual revenue and cost numbers will be released in public filings.

An interesting aspect to Facebook is that Zuckerberg appears to have been focused initially on building the size of the network—or number of users—before he started worrying about income. Given the importance of attaining size and market share to keep out competitors, this approach seems to have paid off. On the other hand, the company needed money just to pay operating expenses such as programmer salaries, office space, and server costs. Ultimately, server and Internet costs can be expensive. Servers and bandwidth to handle millions of customers a day can become expensive. Facebook was able to obtain private financing relatively early—$12.7 million in May 2005 and $27.5 million in April 2006 (Facebook Web site/timeline). In 2007, Microsoft invested $240 million in Facebook.

Ultimately, individuals and venture capital firms provide money to companies because they get ownership in the company. That ownership pays off either through dividends or when the owners decide to issue public stock in an initial public offering (IPO). At that time, the investors can sell their holdings to the public—hopefully at a much higher value than the amount they put into the firm. In the meantime, it is difficult for investors and entrepreneurs to make money—other than through salary. Some early owners of Facebook stock took an intermediate step and began selling their shares privately. In fact, in 2011, Facebook teamed with the investment bank Goldman-Sachs to offer private shares of the company. The company passed the 500-shareholder mark sometime in 2011, which means that it will be required to publicly file its financial reports with the securities and exchange commission (SEC) by the first quarter of 2012 (Press release January 21, 2011).

The stock/ownership issues are only one part of the Facebook story—or for any startup firm. Ultimately, growth means providing a product that benefits users or customers. And it requires continual improvements—adding new features and identifying what customers will want tomorrow. Web software is a particularly challenging product because people want it free, and it is difficult and expensive to find good programmers to keep adding features.

Questions

1. What features does Facebook have that might encourage people to keep using the site instead of moving to a different site?
2. Why is growth so important to a Web-based firm and what costs does it impose?
3. Can Google or some other firm take customers away from Facebook?

Additional Reading

Carlson, Nicholas, "At Last—The Full Story of How Facebook Was Founded," *Business Insider*, March 5, 2010.

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Womack, Brian, "Facebook 2010 Sales Said Likely to Reach $2 Billion, More than Estimated," *Bloomberg*, December 16, 2010.

Sullivan, Danny, "Facebook: You've No Right to Export Email Addresses (Unless It's To Yahoo & Microsoft)," *Search Engine Land*, November 9, 2010. http://searchengineland.com/facebook-you-have-no-right-to-export-email-addresses-55247

Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Part 4

Organizing Businesses and Systems

How do managers organize and control businesses and information systems?

How are information systems created? How should information system resources be organized? How do information systems affect society?

Information technology provides new ways to organize businesses. In particular, the Internet makes it possible for firms of any size to conduct business around the world. But creating these new structures requires thought, effort, and time. Experience shows that it is easy to make mistakes and waste huge amounts of money. Organizing and planning are critical to avoiding these problems.

Because of their importance in a modern firm, information systems must be carefully planned, designed, and maintained. Business managers are increasingly involved in designing and organizing MIS resources. Managers need to understand the difficulties faced in systems development to understand the rules and processes. As technology changes, the organization of business operations and the MIS resources is changing. By identifying these changes, business managers can improve their operations and make better use of new information technologies.

Changes in technology and business cause fundamental changes in society. These changes affect everything from education to government to our daily lives as employees and citizens. Changing technology brings new responsibilities and problems. As managers and citizens we will face many new decisions. We must always remember our ethical responsibilities to other members of society.

Chapter 12

Systems Development

Chapter Outline

What You Will Learn in This Chapter

- How do you create the software tools needed for your organization?
- What main options exist for building information systems?
- What are computer programs?
- How do you control a major development project?
- Is SDLC always the best approach? What other methodologies could be used?
- How do you analyze and annotate a process-based system?
- How is object-oriented design different from process design?
- Can software be located in multiple places?
- How does cloud computing change software development?

Federal Aviation Administration

Why is it so difficult to develop software? Developing software for complex systems is a difficult task. Even bringing in outside contractors has not solved all of the problems for the FAA. Cost overruns and missed schedules have happened so many times in FAA (and other government) projects that completing a project on time is the rare exception.

The FAA is charged with controlling civilian and military uses of U.S. airspace. The FAA is also responsible for modernizing the airways, installing radar, and training air traffic controllers. Probably their best-known function is control over commercial flights and routes to maintain safety and efficiency. With 50,000 flights a day among 300 major airports, the FAA has a huge task.

The FAA has a computer system to help it control the thousands of daily flights. However, the system was created in the early 1960s. It has been patched and upgraded, but most of the hardware and software are based on decades-old technology. On several occasions, the FAA attempted to upgrade the facilities, but complications have forced the agency back to the old technology.

The FAA systems are particularly difficult since they entail high-risk operations that have to be performed accurately. Also, the technology is relatively unique and development often requires state-of-the-art skills in areas that are rarely taught or researched in schools. Also, large-scale projects are always difficult to forecast, because any number of things can go wrong.

Introduction

How do you create the software tools needed for your organization? Today, most companies have chosen not to develop software. In most cases, it is simpler to buy the tools from existing companies. Still, tools often need to be customized and sometimes small applications can make a big difference in how your company operates. As a business manager, you will probably not become a programmer or systems developer. On the other hand, at some point, you will have to interact with developers to ensure that you get the systems you need. You need to be able to communicate with the developers, and you need to understand their constraints. Furthermore, as a manager, you need to understand the costs and management issues facing MIS departments. You might have to choose among development methodologies, so you need to know the options and their strengths and weaknesses.

As shown in Figure 12.1, creating software systems is a difficult task, similar to creating highly-complex buildings. The tools have gotten better over time, but the tasks are much harder. Several cases and stories exist of failed projects—some costing millions of dollars ended up being discarded. Some studies have reported that half or more of software development projects are over budget and behind schedule. However, these numbers are merely estimates because most schedules are best guesses. Building anything entails guesswork on schedules. If you are creating something you have built a hundred times before, you will have a pretty good idea of how long it will take. But, software generally involves creating totally new systems—often with new hardware and new tools. This process is more like the challenges faced by Boeing

Figure 12.1

It is not easy to create information systems to support business needs (strategy, tactics, and operations). Three basic development techniques are: systems development life cycle, prototyping, and end-user development. As a manager, you will participate in each of these methods. You will sometimes have to choose which method to use.

in designing and building the new 787 model—which fell several years behind schedule. Boeing is certainly one of the best companies at designing and building airplanes, yet the challenges faced in using new materials and new construction techniques caused many problems and delays. With large complex projects, it simply is impossible to predict all possible delays.

Small projects that can be built by one person are relatively easy. The challenge lies with large projects that involve many users and many programmers. These systems need to be split into smaller pieces—where the pieces are assigned to teams and eventually to individual programmers. But, splitting a project means that everyone has to work together to share their designs and progress. The pieces have to fit back together and still meet the overall objectives. The system needs a solid plan and control mechansims to ensure everything works together and stays on schedule.

The essence of managing software development comes down to coordinating dozens or hundreds of programmers and several methodologies have been created to handle the common tasks. The most formal approach is known as the **systems development life cycle (SDLC)**. Its structure and concept were borrowed from engineering and construction of large physical items such as bridges and dams. Large organizations that develop several systems use this method to coordinate the teams, evaluate progress, and ensure quality development. Most organizations

Trends

Internally, computer processors have limited capabilities. The processor has a set of a few hundred internal instructions that it knows how to perform, such as moving a number to a new place in memory or adding two numbers together. Initially, all computer programs were written at this low level; but writing programs at this level is difficult and time consuming. Over time, two major innovations were created to reduce the difficulty of programming at these low levels: (1) higher-level languages were created that handle many details automatically for the programmer, and (2) common algorithms used by many applications were created and sold as operating systems. These advances enable programmers to focus on the applications instead of machine-specific details.

Despite many advances, writing programs is still complex and time consuming. Large-scale applications require the teamwork of millions of hours of programmer time and cost hundreds of millions of dollars to build and maintain. These high, fixed development costs underlie the growth of the commercial software industry. By making the software relatively generic and selling it to hundreds or thousands of firms, the development costs are spread over a wider group.

Increasingly, firms are moving away from custom-written software. They are purchasing packages and hiring outside programmers to develop many components. In these situations, design issues generally consist of choosing and customizing the software to meet the individual needs of the organization.

have created their own versions of SDLC. Any major company that uses SDLC also has a manual that is several inches thick (or comparable online documentation) that lays out the rules that MIS designers have to follow. Although these details vary from firm to firm, all of the methods have a common foundation. The goal is to build a system by analyzing the business processes and breaking the problem into smaller, more manageable pieces.

Improvements in technology also improve the development process. The powerful features of commercial software make it easier to build new applications. Programmers and designers can work with larger, more powerful objects. For example, instead of programming each line in COBOL, a report can be created in a few minutes using a database management system or a spreadsheet. **Prototyping** is a design technique that takes advantage of these new tools. The main objective of prototyping is to create a working version of the system as quickly as possible, even if some components are not included in the early versions. A third method of creating systems, **end-user development**, relies on users to create their own systems. This method typically uses advanced software (such as spreadsheets and database management systems) and requires users who have some computer skills.

It is important to be careful when you implement any new system. Case studies show that major problems have arisen during implementation of systems. In fact, some organizations have experienced so many problems that they will deliberately stick with older, less useful systems just to avoid the problems that occur during implementation. Although changes can cause problems, there are ways to deal with them during implementation.

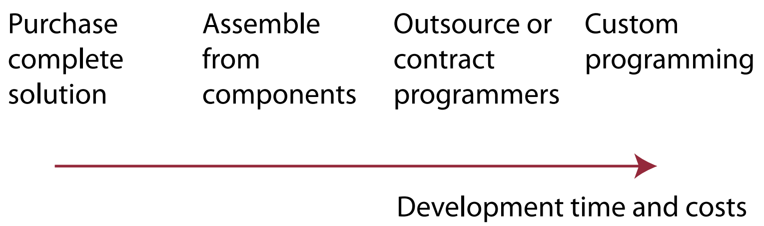


Figure 12.2

Build or Buy. Buying software is much faster and easier even if it requires some customization. Other options require more time, and time means higher costs plus more risks. But sometimes you have no choice but to build a customized application.

There have been some spectacular failures in the development of computer systems. Projects always seem to be over budget and late. Worse, systems are sometimes developed and never used because they did not solve the right problems or they are impossible to use. Several design methods have been created to help prevent these problems. All methods have advantages and drawbacks. As a result, they tend to be suitable for different types of problems. As a manager, you need to be aware of these different tools and their strengths so you can ensure the right methodology is used for your projects. Sure, you could call in EDS, Accenture, or IBM to work on all of your projects—but it would be absurdly expensive to use these formal methods for tiny projects. You know not to call Boeing to help you build a paper airplane, but how do you know when you need help turning your hundreds of spreadsheets into a Web-based application?

Figure 12.2 shows one of the initial issues you will face when looking for new systems. Buying a system is the easiest, fastest method of getting a new application that works. It might have to be customized to meet the needs of the company, but customizing existing software is easier than starting from scratch. If the exact tool you want is not available, you might be able to build something close using other components. For instance, a Web site could be created by adding a shopping cart, chat room, and payment processing components. If you need a more specific component, you could hire a contract programmer to write it. Creating small, clearly-defined components is usually straightforward and can be done without huge management costs. For truly unique systems, it is still necessary to hire programmers and developers and build most of the elements from scratch. This type of development requires the most oversight and control.

Building Information Systems

What main options exist for building information systems? Figure 12.3 illustrates the three primary methods of creating or customizing a business application that you are likely to encounter as a manager. When you need to create or customize an application, you ultimately have to choose some variation of these three. Many alternatives exist, but these three represent anchors. SDLC tools are used for large, critical projects involving many developers because they foster control and repeatability. On the other side of the spectrum, small projects such as reports, queries, charts, and data analysis can be handled completely by end users—with the appropriate training and experience. As long as you, the user, has the tools and business knowledge, it will often be faster for you to develop

Figure 12.3

Primary methodology choices. Business applications need to be developed or customized and you have to choose which methodology to use. These three anchor the primary choices. Large, critical projects need the control of SDLC. On the other side, individual users can build their own applications if they are small enough.

and customize applications to meet your own needs. If you lack the skills to build the application yourself but the project is not too complex, a developer with the skills and tools can work with you to design and build the application.

Another way to look at the problem of software development is to recognize that ultimately developers have to write detailed program code. If your needs are similar to those of other businesses, companies might have already created a commercial application that you can use or customize. If you can buy existing software or even components, the cost is substantially lower, and you reduce risk by using code that has already been tested.

Custom Programming

Ultimately, all applications are created by teams of programmers writing detailed code. Writing your own custom program gives you complete control over the application. You can include any features, build in special routines unique to your company, and integrate the data with your existing systems. The problem with creating your own code is that programming is difficult, time consuming, hard to control, and expensive. Even when the application is completed, you will still need groups of programmers to fix problems, add new features, and develop future versions of the software. Modern development tools make it easier to write programs today, but every application still requires intense development efforts, and the tools never seem to provide all of the features you need.

Reality Bytes: System Development Methodologies

Accenture is the largest worldwide consulting firm in management information systems. It conducts major installations using a proprietary methodology called Method/1. Method/1 uses four phases in the development process: plan, design, implement, and maintain.

McKinsey and Co., a strategic consulting firm, examines organizations with a copyrighted "Seven S" model. The Seven S's are structure, systems, style, staff, skills, strategy, and shared values.

Electronic Data Systems (EDS), started by Ross Perot, purchased by GM, and now independent, is the largest outsourcing company. It also develops systems using a traditional SDLC methodology. The detailed methodology has thousands of individual steps spelled out on separate pages that must be signed off at each step.

Rational Rose, a tool to support object-oriented development, was designed by the leading OO gurus. It is a graphical tool designed to show the object details and their relationships. It supports reverse engineering, by reading existing code and converting it into the corresponding diagrams. The Rose tool can also generate the final code from the diagrams.

Microsoft, as a commercial software vendor developing highly complex systems used by millions of people, has developed its own methodologies for quickly creating code. The company has been a proponent of Rapid Application Development to reduce the time it takes to complete large projects. The methodology is designed to segment the code so that hundreds of programmers can work on it simultaneously. The methodology also relies on creating code that can be modified later, for improvements and patches.

With *Open Source*, led by Richard Stallman and the GNU project, thousands of programmers around the globe are building complex projects in a loosely-knit organization. Generally, one person is a project leader responsible for setting strategies and resolving disputes. All of the source code is publicly available to anyone (hence the name). Interested programmers suggest improvements and submit the modifications. Some complex systems have been built this way with minimal central control.

Quality and security are two critical issues with any type of development. If you build a custom application, you must leave sufficient time to build in quality tests and to correctly build security controls. Employees also have to be trained in these two areas, and you generally need specialized mangers to oversee each of these two areas.

Outsourcing and Contract Programmers

One of the other problems with creating your own software is that you generally have to hire many programmers at some point in the development. But when the development is finished, you will rarely need all of these programmers. So, either you find new tasks for them or you have to release them to reduce your costs. But hiring and firing workers for a single project is frowned upon. Consequently, many firms use contract programmers, or even outsourcing, to handle system development.

With contract programming, you negotiate with a company to provide specialists for a given period of time. When their work on the project is complete, they move on to another job. The process saves you the problems of hiring and firing

Reality Bytes: It Doesn't Get Easier

Developing software is hard. The bigger the project, the harder it is to manage the team. Engrave these rules in stone, developers have faced them for decades, and still the process does not get easier. Fred Brooks (*The Mythical Man Month*) described the problems in detail regarding a 1960s IBM project. Scott Rosenberg (*Dreaming in Code*, 2007) explains how the problems still exist. He was project manager on an open source project to create a new personal information manager called Chandler. Two dozen programmers struggled on the project for over three years. The project is still unfinished (0.7) and searching for more developers. In an interview, Rosenberg points out two major insights into the development process. "If we try to design a system that is fully featured and complex and does everything everyone wants it to, we'll never have any system." "Break things up into small bites. Any opportunity you have to do that should be seized." He also emphasizes that it is difficult, expensive, and time-consuming to develop new software. For example, "even at Microsoft prices it's cheaper to use Word than to write a new word processor." New software is developed when people find new tools and need better ways to work with data. But developing software is hard. Start with a reasonable goal and get something out the door. If it works, improve it.

Adapted from Edward Cone, "Scott Rosenberg: What Makes Software So Hard," *CIO Insight*, January 5, 2007.

large numbers of employees. On the other hand, contractor salaries are usually higher than traditional employees. More important, several lawsuits have made it critical that you clarify the exact role of contractors—otherwise they can sue to be classified as regular employees to gain additional benefits such as stock options.

Outsourcing goes a step further than contract programming. When you outsource project development, you transfer most responsibility to the outside firm. Typically, you negotiate a development price, provide detailed specifications, and the outsourcer hires workers and develops the system. A huge variety of outsourcing arrangements are available, including situations where the outsourcers run your entire MIS department or just your servers or networks, or handle PC maintenance.

The primary advantage of outsourcing is that the external company takes responsibility for managing the process and producing the application. You still have the responsibility to clearly define exactly how the application should work, but the outsourcer bears more of the risk—particularly with fixed-fee contracts. The one thing you want to avoid with contractors and outsourcers is uncontrolled hourly fees.

Assemble Applications from Components

A good way to reduce development time and costs is to buy portions of the system from other companies. Even if you need a custom solution, you can purchase a variety of software components that handle many of the difficult tasks for you. Components are a powerful feature of modern operating systems. They are blocks of code that are integrated into custom applications. For instance, you could purchase a security control to handle encryption on a Web site. Whenever your application needs to encrypt or decrypt some data, it simply calls the component's methods. Similarly, if you need to process a credit card application, you can install a component (or link to a Web service) that handles everything for you. Thousands of useful components are available for a few hundred dollars each or less. You simply install the component on your server and your programmers can begin using the functions within their code. This approach relies on the capabilities of **commercial off-the-shelf (COTS) software**. As the number and quality of software packages have increased, it has become easier to build a system based on COTS.

Increasingly, tasks currently performed by components are being offered as services over the Internet. The same principles will apply, but the external company will maintain the application, install upgrades, and add new features. In addition, new services will become available. For example, services provide instant exchange rate conversions so that you can list prices in any currency. The conversion rates will always be current with no effort on your part.

Components have many substantial advantages and only minor drawbacks (primarily the price hassles with upgrades). They can significantly reduce development time and provide powerful features that are beyond the capabilities of many staff programmers. In fact, many outsource specialists develop their own collection of components to use in developing custom solutions. By integrating commonly used features, they can build new applications faster with fewer errors.

Purchase an External Solution

Taking the concept of components and outsourcing a step further, many commercial software companies sell prepackaged applications. Some are *turnkey* systems where you simply load your data, select a few preferences, and the system runs (much like buying an automobile, you turn the key and no assembly is needed). Other applications require detailed customization. The ERP packages (such as SAP) are classic examples. The system handles all of the basic operational data of the firm, including generation of financial reports. You purchase the software from the vendor and install it on top of a database management system. You still have to set up your accounts and some custom details for reports. The application can then be used by your company to track all financial and manufacturing data and produce standardized reports.

On the other hand, you can also customize most of the features. If you need unique manufacturing reports, you can write code to generate them. The degree of customization often depends on the attitude of management. The drawback to extensive customization is that it requires specially trained programmers and delays the entire project. Moreover, when the DBMS vendor or the ERP vendor upgrades the underlying software, you may have to rewrite all of your custom programs.

Prewritten packages can have high price tags (SAP costs can easily run into millions of dollars). But it could take millions of hours of programmer time to create a custom system with the same functionality.

In general, it is almost always preferable to buy solutions, but keep a close eye on prices. The commercial software essentially spreads the development costs across thousands of firms. Unless you have a truly unique application and are willing to pay a staff of top-notch programmers, it is better to share the development costs. And if you do have a radically different application, you should consider packaging it and selling it to other firms to reduce your costs.

Sequential execution: Statements are executed in order.
Parallel execution: Groups of code are executed at the same time.
Variables: Containers to hold data
Computations
Conditions: If – Then – Else
Loops: While – End
Subroutines and Functions: Break code into manageable pieces.
Input/Output: Transferring data

Objects: Code pieces purchased or created to do specific tasks.

Figure 12.4

Programming structures. Computer programs are developed by using these basic concepts. You can purchase prewritten objects and functions to handle many common tasks. But, you have to understand the objects and learn how to use them.

Computer Programming

What are computer programs? To begin to understand the development process, it helps if you know a little bit about how programs are written. The goal of this section is to help you understand the level that programmers deal with and to help you read the initial products. Programmers often write pseudocode or outlines that you need to be able to read to ensure the program will work correctly.

Of course, it takes several books, considerable practice, and good math skills, to become a programmer. But, the foundations of programming are relatively easy to understand. You should check out the Toolbox on programming to see how managers can write a few lines of code to help solve some relatively complex tasks. Figure 12.4 shows the fundamental concepts of programming. Essentially, processors execute one line of code at a time and follow your instructions. Parallel processing is more difficult because you can have several sections of code executing at the same time, which means you have to worry about which one might finish first; but it leads to faster programs. Variables, computations, conditions, loops, subroutines, and input/output are common features of almost every language. Once you learn the **program logic** of these commands, you can write code in almost any language. Computer languages also possess a **syntax** that dictates exactly how you have to type in the commands, including spelling (case-sensitive), commas, dots, and other annotations. Development tools (such as Microsoft Visual Studio and the open source Eclipse) make it easier to enter code correctly by prompting with syntax options and verifying the items as you type them.

Programming Logic

Figure 12.5 shows a tiny sample program. Instead of following the syntax of a particular language, it uses pseudocode to illustrate the logic. Several additional statements would be needed to turn this code into an application that runs. On the other hand, almost no one would ever write this code because you can use SQL to accomplish the task easier and faster. But, its simplicity makes it a good starting point. Pay attention to the role of the Total variable as an accumulator. It represents one location in memory that acts as a container. Initially, zero is placed in that container. Each time a row of data is read, the number currently stored in the

```
Variable Total = 0
Open Sales
While NOT Sales.EOF
     Total = Total + Sales.Value
     Sales.MoveNext
End
Print Total
Close Sales
```

Declare and initialize variable

Loop through file/query one row at a time until end of file. Retrieve value and accumulate in total variable.

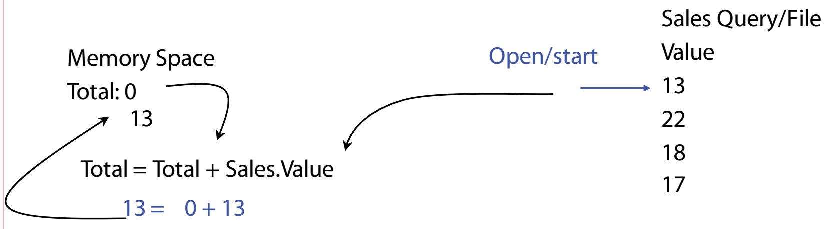


Figure 12.5

Sample code. Note the role of the variable Total as an accumulator. Also notice how the loop walks through the query file one line at a time until all elements have been read. Each time a new row is read the accumulation statement is executed to add the current value of Total to the query value and store the results back into the Total variable.

Total location is retrieved and added to the value from the query. This computation is performed within the computer processor itself. The result is transferred back to memory. The loop causes the processor to retrieve each row from the query and execute the accumulation statement until the end of file is reached. The program code itself is also stored in memory while it is being executed. Loops and conditions are common elements of any program. A conditional statement consists of an IF statement, such as *if (Total < 0)*, and a set of statements to execute only if the condition is true. Many programs also contain *else* statements that are executed only if the condition is false.

Writing code is partly science and partly art. It takes practice to learn how to translate what you want into detailed code statements. But, writing code can be fun and creative. You get to tell the computer exactly what you want it to do, and you get to create something that people can see and use. Programmers also have to be detail-oriented. Small errors in logic or typing can be difficult to find and correct. This combination of creativity, logic, and detail-orientation is difficult to find; which partly explains why good programmers receive relatively high salaries.

Figure 12.6 lists a few of the programming languages in use today. Many of the languages have a similar syntax—loosely based on the earlier C language. But subtle syntax and critical structural differences exist among the languages. A key difference exists with C and C++ because they are both compiled down to assembly code which provides detailed control over the computer and has high performance. Many of the other languages run on an intermediate level which handles data and interfaces differently. It is easier to write code in these languages (such as Java and C#), but performance can be an issue for some types of problems. Other languages (notably Javascript) are dynamic or script languages which are often

Language	Main Purpose or Context
Java	General purpose. Designed to run on servers and clients.
C#, VB, ASP .NET	Microsoft used for Web servers and applications. Managed code.
Javascript, HTML5	Script language for Web page interactivity.
C++, C	Compiled, powerful, lower-level languages often used for systems and tools or where speed is critical.
PHP, PERL, Python, Ruby	Web server scripting/dynamic languages often used on Linux/UNIX or Apache Web servers.
Objective-C	Apple's language for iPhone/iPad applications.
Flash (Adobe) Silverlight (Microsoft)	Special purpose Web add-ins with code to control interactivity. Silverlight uses C# or VB.
COBOL	Older business applications, and SAP.
FORTRAN	Older scientific programming applications, but check out F#.

Figure 12.6

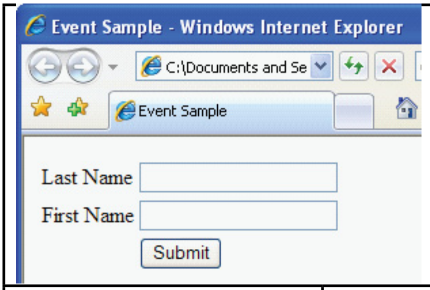
Some programming languages. Religious wars have arisen among geeks over which language is better. Many of the languages have a similar syntax, but the framework and structures can be radically different.

parsed from text only when the code is executed (run time) and can run even more slowly.

Programming requires learning more than just the syntax and structure of a given language. Each program runs within a framework or environment that can limit the actions available and also provide detailed tools and options. For instance, the Windows operating system provides detailed controls for interacting with the screen, the user, and other devices. Writing code for a Web server uses a different set of tools, libraries, and events.

Events

Today, understanding programming logic and syntax is only the first step in learning to program. Most programming environments are **event-driven** systems where programmers create code function that are executed when some event is triggered. You are familiar with these systems as a user, but you might not have realized what was happening. Most of the user interfaces today are based on graphical screens and forms, including Web pages. Each of these environments defines dozens or hundreds of events. Programmers can write code that attaches to an event and then action is taken when that event occurs. As a simple example, Figure 12.7 shows a partial Web form and lists the events that can be activated by the Submit button. A programmer can write Javascript code for any of those events that will



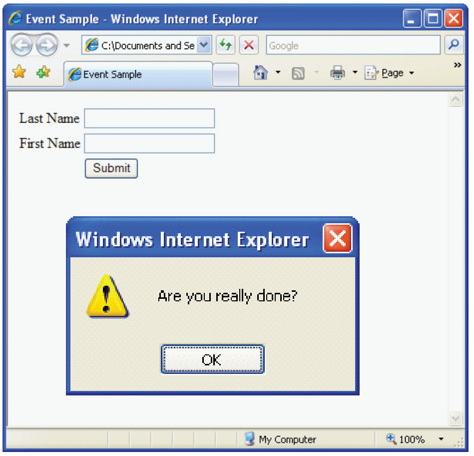
onactivate	ondrag	onmouseleave
onafterupdate	ondragend	onmousemove
onbeforeupdate	ondragenter	onmouseout
onbeforecopy	ondragleave	onmouseover
onbeforecut	ondragover	onmousewheel
onbeforedeactivate	ondrop	onmove
onbeforeeditfocus	onerrorupdate	onmoveend
onbeforepaste	onfilterchange	onmovestart
onbeforeupdate	onfocus	onpaste
onblur	onfocusin	onprerender
onclick	onfocusout	onpropertychange
oncontextmenu	onhelp	onreadystatechange
oncontrolselect	oninit	onresize
oncopy	onkeydown	onresizeend
oncut	onkeyup	onresizestart
ondatabinding	onload	onselectstart
ondblclick	onlosecapture	onserverclick
ondeactivate	onmousedown	onunload
ondisposed	onmouseenter	

Figure 12.7

HTML Javascript events for the Submit button. Any event can cause code to execute. Having more events gives programs more flexibility, but rarely are more than three or four used for a specific problem.

be executed when the event is fired. If you think 56 events is too many, go online and check to see how many exist now. Adding events creates more flexibility and granularity in responding to subtle changes, so new events are periodically added to the Web standards.

In most situations, as the programmer, you have to identify which event most closely matches an action that you want the code to take. Rarely will you need more than one or two events for a given object, and the onclick event is popular. In this example, the onclick event is fired whenever the user clicks the Submit button. However, it is often better to use the onsubmit event associated with the form object instead. The onsubmit event is triggered regardless of how the form is submitted (via a click or via some other lines of code). The distinction is subtle, but one of the tricky aspects of programming is that you need to completely understand all of these subtle differences—for hundreds or thousands of events. To make it easier to learn to program and to reduce mistakes, most programmers and companies develop a set of **best practices** that spell out the best way to handle typical problems. Good programming books list and follow these best practices.




```
<input type="submit" value="Submit" name="submit"
onmouseover="ShowMessage('Are you really done?');"  />

<script language="javascript">
function ShowMessage(msg)
{
    alert(msg);
}
</script>
```

Figure 12.8

Simple Javascript example. Whenever the user rolls the mouse over the Submit button, a message box pops up. It is exceedingly annoying to the user, but it shows the effect of the mouseover event.

Figure 12.8 shows a couple of simple lines of code that are executed when a user rolls the mouse cursor over the Submit button. You would never write this code on a real Web page because alerts are exceedingly annoying. However, it is an easy way to verify that the code is executing properly. With a little thought, you could write some conditions for the function that are useful—such as checking to see if the user entered data in all of the boxes. The art of programming revolves around building applications that solve problems and are easy to use.

Object-Oriented Programming

Object-oriented programming (OOP) evolved in the 1990s as a way to make it easier and faster to create new applications. With this approach, the focus is on defining objects that have specific properties (data) and methods (code). All of the common applications you use; including graphical operating systems, personal productivity tools, and Web browsers; were built using OO techniques. The point of this approach is that the internal objects created to build these tools are available for you to use in other programs. For example, you can write a new business program that uses a spreadsheet object and its internal tools. **Reusability** of objects is an important feature of the OOP approach.

Business programmers can use similar techniques to create their own objects. Objects are defined by a set of properties (or attributes). The properties define the object. They also represent data that will be collected for each object. Consider

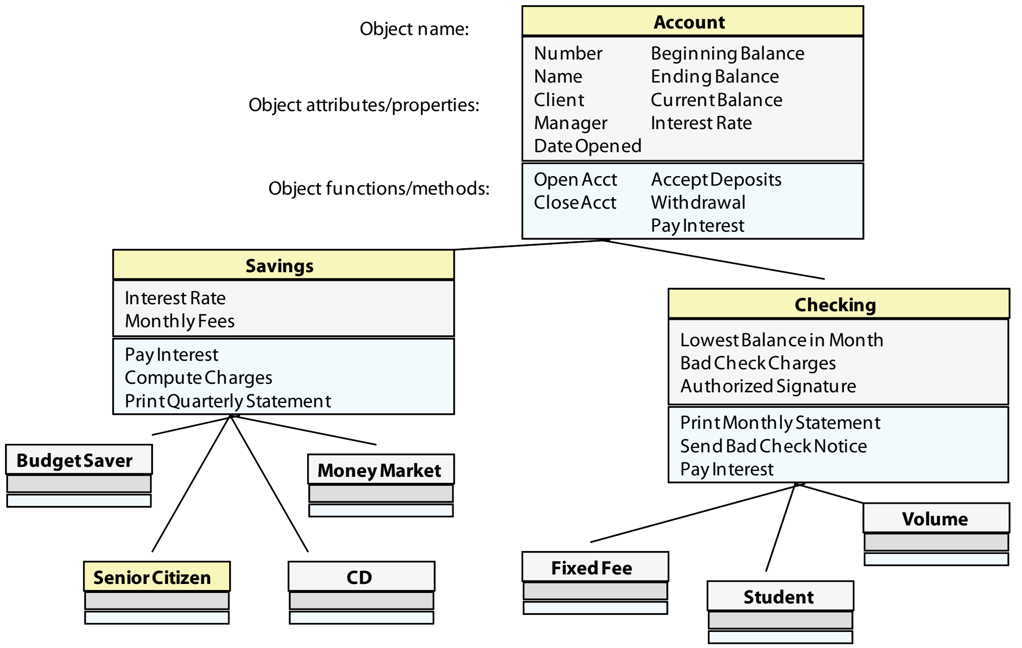


Figure 12.9

Objects: encapsulation, hierarchy, inheritance, polymorphism. Object-oriented design focuses on individual objects and the data within the organization. Processes are secondary and they are usually embedded in the object. By encapsulating these definitions, the objects can be used to develop related systems with less effort. It is also easier to modify a system by making small changes to an object's behavior.

the small example of a banking system. One primary object will be Accounts. A generic account object would have basic properties such as Account Number, Account Name, Client, Manager, Date Opened, Beginning Balance, Current Balance, and Interest Rate. Each object also has functions, which describe actions that can be performed by the objects and define how to alter the object. In the bank example, there would be functions to Open Account, Close Account, Accept Deposits, Pay Withdrawals, and Pay Interest. Note that each type of account could have a different method for computing interest payments. One account might compound them daily, another weekly, and so on. With the object-oriented approach, the properties and functions are combined into the definition of the object. The goal is to describe a system so that if you change a function, you only have to change one object. All of the other objects and processes remain the same.

Objects are related to each other. Typically there is a base class of objects, and other objects are derived from the base definitions by adding properties and altering functions. This process results in an **object hierarchy**, illustrated in Figure 12.9, that shows how the classes are derived from each other. The bank example has several types of accounts with each of these categories containing further subdivisions.

Figure 12.9 also shows detail in the classes by including some of the properties and member functions. The accounts have elements in common that are an

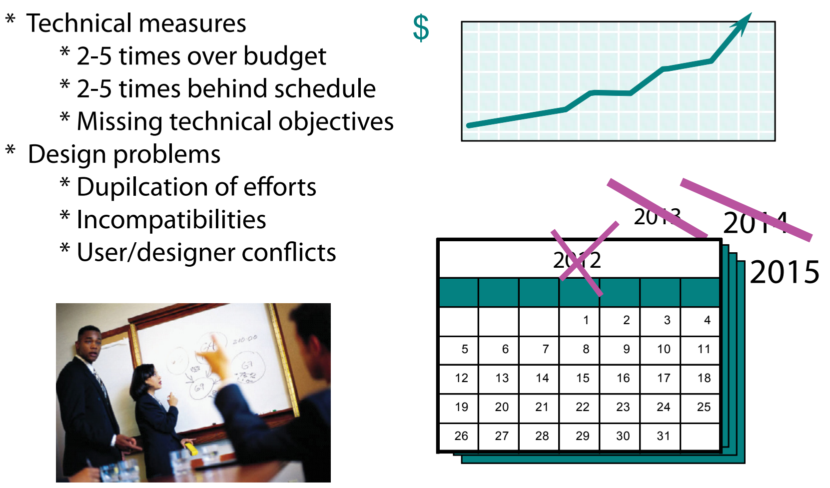


Figure 12.10

Runaway projects. Managers fear runaway projects, but they still occur. Some projects end up two to five times over budget and behind schedule. Some projects are canceled because they never meet their objectives. Some fail because of design problems and conflicts among users, management, and developers. An important step in managing projects is to identify when the project becomes a runaway project.

inheritance from the base class (account), such as the balance attributes. Each level adds additional detail. Each account class also contains member functions to perform operations, such as paying interest. Because the interest computations can be different for each of the accounts, the method is stored with the original definition of each account.

To see the usefulness of the object approach, consider what happens if the bank decides to collect additional data for the checking accounts. The only change needed is to add the new data items (and the associated functions) to the checking account class. All checking accounts will then inherit those properties and functions. None of the other operations are affected. Changes to the information system will only affect the specific accounts; the rest of the system will remain the same.

From Programming to Development

Now that you have an idea of what it takes to create even a simple program, multiply that task by thousands to get a feel for the challenges of building a large, complex application. Plus, the application needs to do what the users want, not necessarily what the programmers want it to do. So someone has to identify business needs and translate those into concepts that the programmers understand. This role is handled by a **systems analyst**. In small projects, the programmers also perform the systems analyst tasks, but in large projects the discussion and design issues are handled by specialists.

In theory, a single programmer could develop almost any application—but you will probably have to wait several years for the project to finish. Keep in mind that the development tools are continually improving, so actually a single programmer today can build a relatively complex system in a short period of time. Projects that once required teams of programmers weeks or months to build can be built in a short time by even a single programmer. However, there are dozens of other details that need to be handled, including testing, installation, documentation, and training. The overall time can be reduced if additional people are hired to handle these tasks, and if the programming can be divided into pieces so additional programmers can work on the pieces at the same time. Whenever you add people to a project, you need a way to assign tasks, communicate ideas, monitor progress, and control the entire process. At this point, you need a development methodology.

Systems Development Life Cycle

How do you control a major development project? Runaway projects illustrated in Figure 12.10 are a substantial problem in any development effort, but they are particularly important for new designs. Building a project from scratch means it is hard to estimate the amount of time and effort needed to build the system. As projects become larger, they become more difficult to monitor and control. Several major projects, including e-commerce firms, failed because they were unable to produce a working system.

A factor in many runaway projects is the concept of **scope creep** or expanding features. Once development starts, users and programmers start thinking of new ideas that they would like to see in the project. So a simple, two-month project for one division suddenly expands into a two-year companywide project costing millions of dollars. A key role of any IT project manager is to politely avoid adding features that are not immediately necessary.

SDLC was designed to overcome the problems that arose with large projects that involve many users and require thousands of hours of development by multiple analysts and programmers.

Before the use of the SDLC method, several related problems were common. It was hard to coordinate and control the various programmers and analysts, so efforts were duplicated. Individual programmers created portions of a system that would not work together. Users did not always have much input into the process. When they did have input, there were conflicts between users, and analysts did not know which approach to use. With long-term projects, programmers were promoted to other areas or left for different companies. New employees had to learn the system and determine what others had done before they could proceed. Similarly, new users would appear (through promotions and transfers), and existing users would change the specifications of the system. These problems often lead to runaway projects—projects that are significantly late and over budget. Even today, there are many instances of runaway projects.

Figure 12.11 shows some of the main risks in software development as outlined by Boehm in 1991. The one at the bottom of the list is an interesting question because it keeps changing. Developers and academics know how to solve certain types of problems. Computer scientists also know some problems that do not yet have good solutions. Any project that pushes these boundaries is going to be difficult to create and hard to control. Organizations need to be careful when entering into projects that are experimental. Dealing with large projects that use standard tools is hard enough to control. Fortunately, most business projects use relatively common technologies. Still, it is easy to get carried away and start believing that computers can perform impossible tasks.

These problems are related through the issue of control. It is impossible to prevent users from changing the specifications and to prevent employees from tak-

- Personnel shortfalls
- Unrealistic schedules and budgets
- Developing the wrong functions and properties
- Developing the wrong user interface
- Gold plating (adding more functionality/features than necessary)
- Continuing stream of requirements changes (scope creep)
- Shortfalls in externally furnished components
- Shortfalls in externally performed tasks
- Real-time performance shortfalls
- Straining computer-science capabilities

Figure 12.11

Project Risks (Boehm 1991). Some of the main risks that can delay or prevent the successful completion of software development projects. Good development practices can reduce some of these risks, but project managers must constantly watch for signs of problems.

ing other jobs. Likewise, large projects involving many analysts and programmers will always have problems with coordination and compatibility. The goal of SDLC was to design a system that can handle all of these problems.

A key value in SDLC is project management. An important aspect of project management consists of identifying the dependencies among the various tasks. Project management tools exist to help evaluate these dependencies and show how the overall schedule is affected by delays in individual tasks.

Introduction to SDLC

An important feature of the SDLC approach is that it is a comprehensive method. Some organizations (such as EDS) that specialize in systems development have hundreds of pages in manuals to detail all the steps and rules for using SDLC. Fortunately, it is possible to understand SDLC by looking at a smaller number of steps. As illustrated in Figure 12.12, the SDLC approach encompasses five basic stages: (1) feasibility and planning, (2) systems analysis, (3) systems design, (4) implementation, and (5) maintenance and review.

Actually, just about any systems-development methodology uses these five steps. They differ largely in how much time is spent in each section, who does the work, and in the degree of formality involved. The SDLC approach is by far the most formal method, so it offers a good starting point in describing the various methodologies.

Feasibility and Planning

The primary goal of **systems analysis** is to identify problems and determine how they can be solved with a computer system. In formal SDLC methodologies, the first step in systems analysis is a **feasibility study**. A feasibility study is a quick examination of the problems, goals, and expected costs of the system. The objective is to determine whether the problem can reasonably be solved with a computer system. In some cases, maybe there is a better (or cheaper) alternative, or perhaps the problem is simply a short-term annoyance and will gradually disappear. In other cases, the problem may turn out to be more complex than was thought and to involve users across the company. Also, some problems may not be solv-

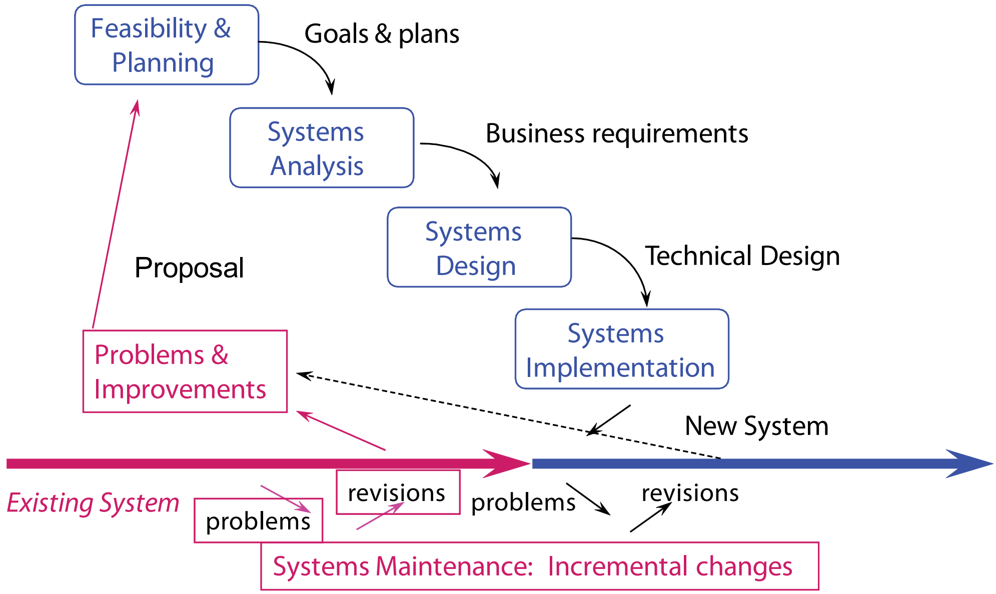


Figure 12.12

Systems development life cycle. Sometimes SDLC is known as the waterfall methodology because each step produces outputs that are used in the next step. The existing system is studied for problems and improvements. A new design is analyzed for feasibility. In-depth analysis generates the business requirements. Systems design turns them into a technical design that is implemented, creating a new system. This new system is analyzed and the process continues.

able with today's technology. It might be better to wait for improved technology or lower prices. In any case, you need to determine the scope of the project to gain a better idea of the costs, benefits, and objectives.

The feasibility study is typically written so that it can be easily understood by nonprogrammers. It is used to "sell" the project to upper management and as a starting point for the next step. Furthermore, it is used as a reference to keep the project on track, and to evaluate the progress of the MIS team. Projects are typically evaluated in three areas of feasibility: economical, operational, and technical. Is the project cost effective or is there a cheaper solution? Will the proposed system improve the operations of the firm, or will complicating factors prevent it from achieving its goals? Does the technology exist, and does the firm have the staff to make the technology work?

When the proposal is determined to be feasible, the MIS team leaders are appointed, and a plan and schedule are created. The schedule contains a detailed listing of what parts of the project will be completed at each time. Of course, it is extremely difficult to estimate the true costs and completion dates. Nonetheless, the schedule is an important tool to evaluate the status of the project and the progress of the MIS teams. As shown in Figure 12.13, planning and scheduling provides the blueprint or structure for the rest of the project. It is a crucial step that provides control for the remaining project.

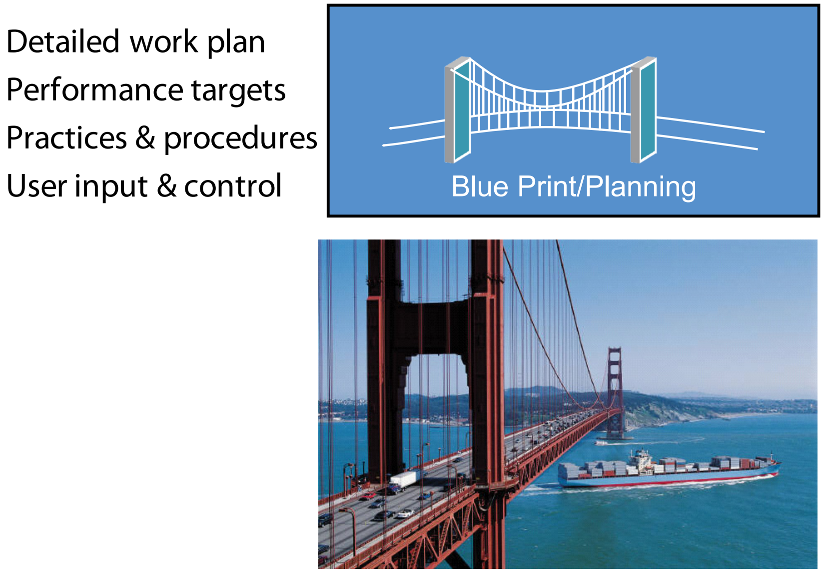


Figure 12.13

Development controls. A complex system requires careful management. Without planning and control, any project will become a runaway. Control begins with a detailed plan and performance targets that enable managers to evaluate progress and identify problems. System control is provided by standardized practices and procedures to ensure that teams are producing compatible output. User input and control ensure that the final project will actually be useful.

Systems Analysis

Once a project has been shown to be feasible and is approved, work can begin on a full-fledged analysis. The first step is to determine how the existing system works and where the problems are located. The technique is to break the system into pieces. Smaller pieces are easier to understand and to explain to others. Also, each piece can be assigned to a different MIS team. As long as they work from the same initial description and follow all of the standards, the resulting pieces should fit back together. Of course, it still takes time and effort to integrate all of the pieces. The key objective in this stage is to understand the business organization and determine the specific requirements for the new project. It is also useful to collect test cases. Modern development systems can be programmed to automatically run test cases as the code is being developed and changed. The test data (with the correct results) ensure that the system always produces accurate results.

Diagrams are often created to illustrate the system. The diagrams are used to communicate among analysts and users, other analysts, and eventually the programmers. Data flow diagrams are a common method to display the relationships that were determined during systems analysis. The diagrams represent a way to divide the system into smaller pieces.

Graphics tools provide a useful way to communicate with the user and to document the user requirements. However, they do not speed up the development process. Producing, changing, and storing documentation can be a significant problem. Yet these tools are necessary because they make it easier for the user

Reality Bytes: What Tech Skills do Employers Want

Because technology continually changes, students are always asking what skills are needed. Actually, even experienced IT employees ask the same question. In 2011, employers said they wanted the several basic skills: 77 percent want programming skills, 82 percent want database skills, 76 percent want analytical and architectural skills, and 80 percent want general problem solving and technical skills. Many employers also want experience, but when the job market tightens, they have few options. In the same study, 50 percent said they were willing to hire new IT graduates; but two-thirds wanted at least some college internship experience.

Adapted from Michael Cooney, "IT Graduates Not 'Well-Trained, Ready-to-go,'" *Network World*, February 25, 2011.

to control the final result. One increasingly common solution is to keep all of the documentation on the computer. This method reduces the costs, makes it easier for everyone to share the documentation, and ensures that all users have up-to-date information for the system.

At the end of the analysis phase, the MIS team will have a complete description of the business requirements. The problems and needs are documented with text, data flow diagrams, and other figures depending on the methodology followed.

Systems Design

The third major step of the SDLC approach is to design the new system. During this step, the new system is typically designed. The objective of systems design is to describe the new system as a collection of modules or subsystems. By subdividing the total project, each portion can be given to a single programmer to develop. As the pieces are completed, the overall design ensures that they will work together. Typically, the diagrams created during the analysis phase can be modified to indicate how the new system will work. The design will list all of the details, including data inputs, system outputs, processing steps, database designs, manual procedures, and feedback and control mechanisms. Backup and recovery plans along with security controls will be spelled out to ensure that the database is protected.

In traditional SDLC methods, managers and users will be shown various components of the system as they are completed. The managers will have to *sign off* on these sections to indicate that they meet the user needs. This signature is designed to ensure that users provide input to the system. If there are many diverse users, there can be major disagreements about how the system should function. Sign-offs require users to negotiate and formally agree to the design. It is relatively easy to make design changes at this stage. If everyone attempts to make changes at later stages, the cost increases dramatically.

In terms of physical design, some of the hardware and software will be purchased. Programmers will write and test the program code. In most large projects, the actual coding takes only 15 to 30 percent of the total development time. Initial data will be collected or transferred from existing systems. Manuals and procedures will be written to instruct users and system operators on how to use the system.

Reality Bytes: You Won. Just Kidding

In 1994, the U.S. Congress created an international green-card lottery. The annual competition randomly selects 50,000 people to live and work legally in the U.S. with minimal other criteria. Almost 15 million people applied for the lottery in 2011. In May, the State Department posted a list of 20,000 winning numbers on its Web site. A few lucky people, such as Max, a 28-year-old German were ecstatic. Until a few days later. The State Department identified a glitch in the computer program that selected the names. Apparently, 90 percent of the numbers selected had applied in the first two days. Deputy assistant secretary of state David Donahue noted that "These results are not valid because they did not represent a fair, random selection of the entrants as required by U.S. law." The lottery has been conducted electronically for 15 years, but the State department blamed a coding error in a new computer program. The department did not provide an explanation as to why no one tested the program ahead of time. The lottery was rescheduled.

Adapted from *The Wall Street Journal*, "Computer Glitch Voids Green-Card Lottery," May 14, 2011.

Design tools can be used to create prototypes of major system elements. For example, a designer can quickly piece together displays that illustrate how each screen might look and how the user will see the system. These prototypes can be used to help users walk through aspects of the proposed system and make changes while it is easy and inexpensive. The walkthroughs also provide management with feedback regarding the time schedule and anticipated costs of the project, because they are often scheduled in the original feasibility study.

The output of the design stage consists of a complete technical specification of the new system. It includes as many details as possible, sometimes leading to thousands of pages (or computer files) of description.

One of the difficulties in the design stage is sometimes called *creeping elegance*. As the system is being built, analysts, programmers, and users all want to include additional features. Although many of the features are good ideas, the continual evolution of the system causes additional delays. It also complicates testing, because changes in one section can affect the rest of the system.

Systems Implementation

Systems implementation involves installation and changeover from the previous system to the new one, including training users and making adjustments to the system. Many nasty problems can arise at this stage. You have to be extremely careful in implementing new systems. First, users are probably nervous about the change already. If something goes wrong, they may never trust the new system. Second, if major errors occur, you could lose important business data.

A crucial stage in implementation is final testing. Testing and quality control must be performed at every stage of development, but a final systems test is needed before staff entrust the company's data to the new system. Occasionally, small problems will be noted, but their resolution will be left for later. In any large system, errors and changes will occur. The key is to identify them and determine which ones must be fixed immediately. Smaller problems are often left to the software maintenance staff.

Technology Toolbox: Creating Forms with InfoPath

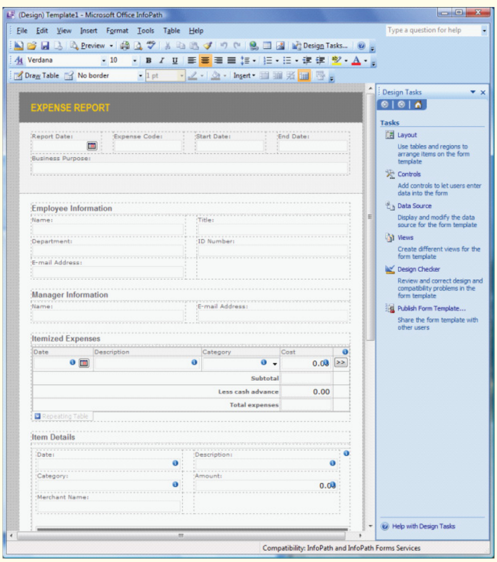
Problem: You want employees to use digital forms to collect basic data such as expense reports.

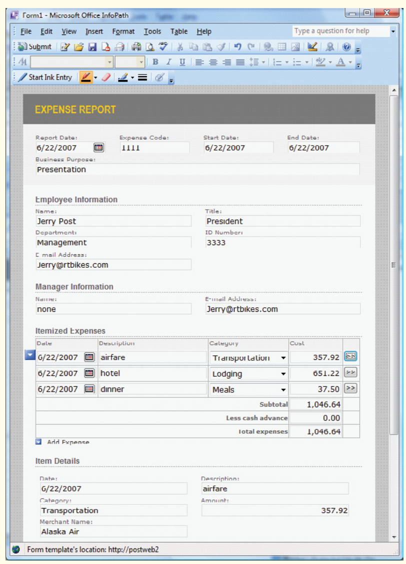
Tools: You can use InfoPath in Microsoft Office to create, exchange, and store data from digital forms.

InfoPath is included with several business versions of Office 2007. It has a forms-builder tool to create forms and define the data that will be collected. Once the form is created, it can be published to a SharePoint server, e-mailed to people, or built into a Visual Studio project. Simple forms can be built that can be opened with just a Web browser, so recipients do not need InfoPath installed on their computers. However, InfoPath forms are more powerful than browser forms.

Creating forms is relatively easy—especially if you can use one of the sample forms included with InfoPath. The basic steps are to define the data elements, then add text and input boxes using the layout tools. After checking the design for errors, you publish the form so employees can fill it out as needed.

The easiest method is to centralize the forms and store them on a SharePoint server. You can use additional tools to build in workflow procedures. The expense report is one of several sample forms included with InfoPath. Employees go to the SharePoint server and create a new form filling out the relevant data. The data is saved on the SharePoint server, and the form is e-mailed automatically to the employee's manager for review. At any time, the manager can see summaries of specified data columns on the SharePoint server site. All data is stored in XML files, so it can be transferred to other systems fairly easily.





Quick Quiz:

1. What standard business forms would you want to create electronically?
2. What security conditions would you impose when installing expense report forms on a SharePoint server?
3. What are the benefits of using digital forms instead of paper forms?

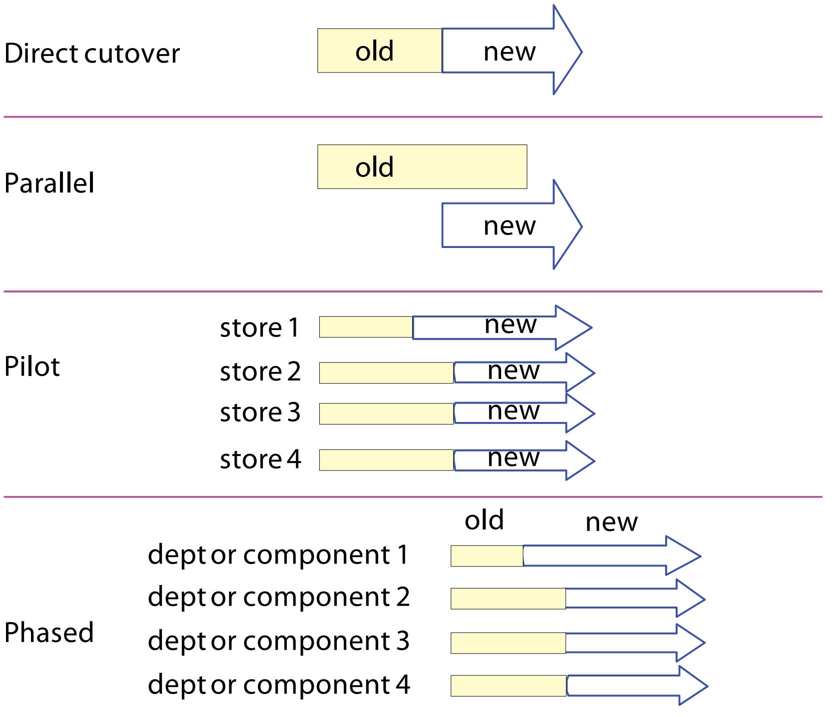


Figure 12.14

Conversion options. When you implement a new system, there are several possible conversion methods. In most cases, direct cutover should be avoided because of the disruptions and potential for lost data. Parallel conversion entails running both systems simultaneously, which is safe but can become expensive and time consuming. With multiple stores or business units, pilot introductions of phased implementations are common. For pilot testing, designers can bring extra workers, managers, and systems designers to one location and work out the problems with the system. Once the system is running well, it can be implemented at other locations. With a phased implementation, a system can be introduced slowly throughout the company (e.g., by department). Projects can also be phased in by modules.

Change is an important part of MIS. Designing and implementing new systems often cause changes in the business operations. Yet many people do not like changes. Changes require learning new methods, forging new relationships with people and managers, or perhaps even loss of jobs. Changes exist on many levels: in society, in business, and in information systems. Changes can occur because of shifts in the environment, or they can be introduced by internal **change agents**. Left to themselves, most organizations will resist even small changes. Change agents are objects or people who cause or facilitate changes. Sometimes it might be a new employee who brings fresh ideas; other times changes can be mandated by top-level management. Sometimes an outside event such as arrival of a new competitor or a natural disaster forces an organization to change. Whatever the cause, people tend to resist change. However, if organizations do not change, they cannot survive. The goal is to implement systems in a manner that recognizes resistance to change but encourages people to accept the new system. Effective implementation involves finding ways to reduce this resistance. Sometimes, implementation involves the cooperation of outsiders such as suppliers.

Because implementation is so important, several techniques have been developed to help implement new systems. Direct cutover is an obvious technique, where the old system is simply dropped and the new one started. If at all possible, it is best to avoid this technique, because it is the most dangerous to data. If anything goes wrong with the new system, you run the risk of losing valuable information because the old system is not available. The various methods are displayed in Figure 12.14.

In many ways, the safest choice is to use parallel implementation. In this case, the new system is introduced alongside the old one. Both systems are operated at the same time until you determine that the new system is acceptable. The main drawback to this method is that it can be expensive because data has to be entered twice. In addition, if users are nervous about the new system, they might avoid the change and stick with the old method. In this case, the new system may never get a fair trial.

Several intermediate possibilities are called **phased implementation**. For example, if you design a system for a chain of retail stores, you could pilot-test the first implementation in one store. By working with one store at a time, there are likely to be fewer problems. But if problems do arise, you will have more staff members around to overcome the obstacles. When the system is working well in one store, you can move to the next location. Similarly, even if there is only one store, you might be able to split the implementation into sections based on the area of business. You might install a set of computer cash registers first. When they work correctly, you can connect them to a central computer and produce daily reports. Next, you can move on to annual summaries and payroll. Eventually the entire system will be installed.

Maintenance

Once the system is installed, the MIS job has just begun. Computer systems are constantly changing. Hardware upgrades occur continually, and commercial software tools may change every year. Users change jobs. Errors may exist in the system. The business changes, and management and users demand new information and expansions. All of these actions mean the system needs to be modified. The job of overseeing and making these modifications is called **software maintenance**.

The pressures for change are so great that in most organizations today as much as 80 percent of the MIS staff is devoted to modifying existing programs. These changes can be time consuming and difficult. Most major systems were created by teams of programmers and analysts over a long period. In order to make a change to a program, the programmer has to understand how the current program works. Because the program was written by many different people with varying styles, it can be hard to understand. Finally, when a programmer makes a minor change in one location, it can affect another area of the program, which can cause additional errors or necessitate more changes.

One difficulty with software maintenance is that every time part of an application is modified, there is a risk of adding defects (bugs). Also, over time the application becomes less structured and more complex, making it harder to understand. At some point, a company may decide to replace or improve the heavily modified system. Several techniques can be used to improve an existing system, ranging

Feasibility Comparison	
Cost & Budget	Compare actual costs to budget estimates.
Time Estimates	Was project completed on time?
Revenue Effects	Does system produce additional revenue?
Maintenance Costs	How much money and time are spent on changes?
Project Goals	Does system meet the initial goals of the project?
User Satisfaction	How do users (and management) evaluate the system?
System Performance	
System Reliability	Are the results accurate and on time?
System Availability	Is the system available on a continuous basis?
System Security	Does the system provide access only to authorized users?

Figure 12.15

Evaluation of completed projects. When projects are completed, the design team should evaluate the project and assess the development procedures. Cost and time estimates can be used to improve estimates for future projects. System performance issues can be addressed with future upgrades. It is important that the system achieve project goals and provide users with necessary tools and support.

from rewriting individual sections to restructuring the entire application. The difference lies in scope—how much of the application needs to be modified. Older applications that were subject to modifications over several years tend to contain code that is no longer used, poorly documented changes, and inconsistent naming conventions. These applications are prime candidates for restructuring, during which the entire code is analyzed and reorganized to make it more efficient. More important, the code is organized, standardized, and documented to make it easier to make changes in the future.

Evaluation

An important phase in any project is evaluating the resulting system. As part of this evaluation, it is also important to assess the effectiveness of the particular development process. There are several questions to ask: Were the initial cost estimates accurate? Was the project completed on time? Did users have sufficient input? Are maintenance costs higher than expected? The assessment items are summarized in Figure 12.15.

Evaluation is a difficult issue. As a manager, how can you tell the difference between a good system and a poor one? In some way, the system should decrease costs, increase revenue, or provide a competitive advantage. Although these effects are important, they are often subtle and difficult to measure. The system should also be easy to use and flexible enough to adapt to changes in the business. If employees or customers continue to complain about a system, it should be reexamined.

A system also needs to be *reliable*. It should be available when needed and should produce accurate output. Error detection can be provided in the system to recognize and avoid common problems. Similarly, some systems can be built to tolerate errors, so that when errors arise, the system recognizes the problem

Strengths	Weaknesses
Control.	Increased development time.
Monitor large projects.	Increased development costs.
Detailed steps.	Systems must be defined up front.
Evaluate costs and completion targets.	Rigidity.
Documentation.	Hard to estimate costs, project overruns.
Well-defined user input.	User input is sometimes limited.
Ease of maintenance.	
Development and design standards.	
Tolerates changes in MIS staffing.	

Figure 12.16

Strengths and weaknesses of SDLC. The SDLC methodologies were created to control large, complex development projects. They work fairly well for those types of processes. They do not work as well for small projects that require rapid development or heavy user involvement with many changes.

and works around it. For example, some computers exist today that automatically switch to backup components when one section fails, thereby exhibiting **fault tolerance**.

An important concept for managers to remember when dealing with new systems is that the evaluation mechanism should be determined at the start of the project. Far too often, the question of evaluation is ignored until someone questions the value of the finished product. It is a good design practice to ask what would make this system a good system when it is finished, or how we can tell a good system from a bad one in this application. Even though these questions may be difficult to answer, they need to be asked. The answers, however incomplete, will provide valuable guidance during the design stage.

Recall that every system needs a goal, a way of measuring progress toward that goal, and a feedback mechanism. Traditionally, control of systems has been the task of the computer programming staff. Their primary goal was to create error-free code, and they used various testing techniques to find and correct errors in the code. Today, creating error-free code is not a sufficient goal.

Everyone has heard the phrase "The customer is always right." The meaning behind this phrase is that sometimes people have different opinions on whether a system is behaving correctly. When there is a conflict, the opinion that is most important is that of the customer. In the final analysis, customers are in control because they can always take their business elsewhere. With information systems, the users are the customers and the users should be the ones in control. Users determine whether a system is good. If the users are not convinced that the system performs useful tasks, it is not a good system.

Strengths and Weaknesses of SDLC

The primary purpose of the SDLC method of designing systems is to provide guidance and control over the development process. As summarized in Figure 12.16, there are strengths and weaknesses to this methodology. SDLC management control is vital for large projects to ensure that the individual teams work together. There are also financial controls to keep track of the project expenses. The SDLC steps are often spelled out in great detail. The formality makes it easier to train employees and to evaluate the progress of the development. It also ensures that steps are not skipped, such as user approval, documentation, and testing. For large, complex projects, this degree of control is necessary to ensure the project can be completed. Another advantage of SDLC is that by adhering to standards while building the system, programmers will find the system easier to modify and maintain later. The internal consistency and documentation make it easier to modify. With 80 percent of MIS resources spent on maintenance, this advantage can be critical.

In some cases the formality of the SDLC approach causes problems. Most important, it increases the cost of development and lengthens the development time. In many cases less than 25 percent of the time is spent on actually writing programs. A great deal of the rest of the time is spent filling out forms and drawing diagrams.

The formality of the SDLC method also causes problems with projects that are hard to define. SDLC works best if the entire system can be accurately specified in the beginning. That is, users and managers need to know exactly what the system should do long before the system is created. That is not a serious problem with transaction-processing systems. However, consider the development of a complex decision support system. Initially, the users may not know how the system can help. Only through working with the system on actual problems will they spot errors and identify enhancements.

Although some large projects could never have been completed without SDLC, its rigidity tends to make it difficult to develop many modern applications. Moreover, experience has shown that it has not really solved the problems of projects being over budget and late. As a result of this criticism, many people are searching for alternatives. One possibility is to keep the basic SDLC in place and use technology to make it more efficient. Other suggestions have been to replace the entire process with a more efficient development process, such as prototyping. Consider the assistance of technology first.

Several researchers at Carnegie Mellon University have created (and trademarked) the **capability maturity model integration (CMMI)** to help development organizations evaluate their abilities. Figure 12.17 shows the various levels of maturity. The goal is to improve the development process within an organization so that everyone follows a process that is measurable and sustainable. In standard management terms, quantifying the development process makes it possible to fine-tune and improve. Possibly the greatest strength of the CMMI approach is also one of its weaknesses. The overall approach is designed to support and encourage mediocrity in development. Programmers are considered interchangeable—an organization that succeeds by relying on "star" programmers is considered to be inferior. For some large organizations (particularly governments), this characterization makes sense—the system should function even with staff turnover. The weakness is that some software development requires creativity and flexibility to create new approaches.

Alternatives to SDLC

Is SDLC always the best approach? What other methodologies could be used? The two primary drawbacks to SDLC are that (1) it takes a considerable amount of time, and (2) all the system details have to be specified

1. **Initial**. Ad hoc development with undefined processes. Often driven by individual programmers.
2. **Managed**. Standard project management tools to track costs and schedules. Basic processes to ensure development is repeatable.
3. **Defined**. Management and development is defined and standardized. Processes are documented and followed.
4. **Quantitatively Managed**. Detailed measures are collected and evaluated.
5. **Optimizing**. Continuous improvement methods are applied to fine-tune and improve the development process.

Figure 12.17

Capability Maturity Model. Based on standard management techniques. A development organization should strive to install processes, measure progress, and improve the development methodology.

up front. The project management and control features add paperwork and delays, making SDLC unsuitable for small projects. SDLC works reasonably well for transaction-processing systems that are well defined where the design elements can be specified up front. It does not work well for decision support systems particularly when users do not really know exactly what they want the system to do.

Prototyping or Iterative Development

Prototyping has been proposed as a method to use for systems that are not overly complex and do not involve too many users or analysts. Just as automobile engineers design prototypes before attempting to build the final car, MIS programmers can build early versions of systems. These systems are then continually modified until the user is satisfied.

The first step in designing a system via prototyping is to talk with the user. The analyst then uses a fourth-generation language and a DBMS to create approximately what the user wants. This first step generally requires only a couple of weeks. The business user then works with the prototype and suggests changes. The analyst makes the changes and this cycle repeats until the user is satisfied or decides that the system is not worth pursuing. The emphasis is on getting a working version of the system to the user as fast as possible, even if it does not have all the details. Figure 12.18 illustrates the cycle involved in prototyping.

The major advantage of prototyping is that users receive a working system much sooner than they would with the SDLC method. Furthermore, the users have more input so they are more likely to get what they wanted. Finally, remember that a large portion of MIS time is spent making changes. A system designed with the prototyping method is much easier to change because it was designed to be modified from the start.

Extreme Programming and Agile Development

In some ways, **extreme programming (XP)** is a new concept; in other ways it is an extension of the prototyping ideas. The main premise of XP is that SDLC and its variants are too large and cumbersome. While they might provide control, they end up adding complexity, taking more time, and slowing down top programmers.

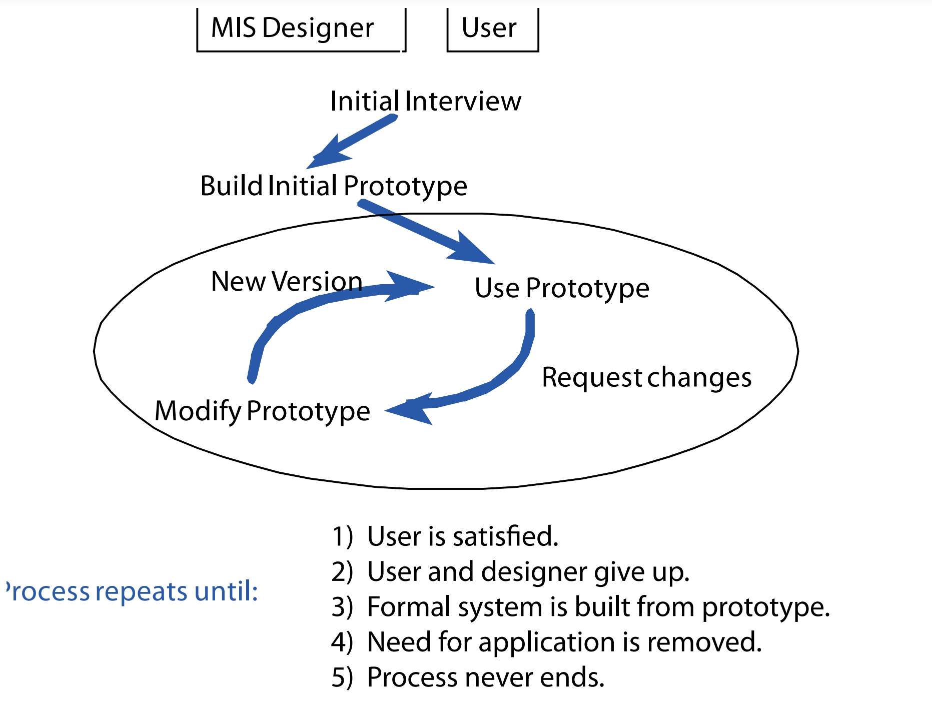


Figure 12.18

Prototyping. Prototyping typically involves one user and one developer. The developer interviews the user and designs an initial system using a DBMS. The user works with the prototype and suggests changes. This process repeats until the user or developer is satisfied or gives up.

XP and agile development simplify the development process by focusing on small releases (similar to prototyping) that provide value to the customer.

As shown in Figure 12.19, XP and agile development were pushed heavily in the development of new Web-based systems. In this highly-competitive environment, getting applications out the door and on the Web quickly was more important than loading on tons of features. Yet, everything had to work correctly. To improve quality XP adopted a relatively new principle from computer science: building test cases first. The basic system is designed in terms of what each module should accomplish. These features are defined with a set of test cases. Programmers then write code and feed the test cases through to ensure the modules work correctly. Whenever the system is changed, the programmers rerun the test cases to ensure nothing else was broken. Tools were developed to store the test cases and the results, making it easy to develop new cases and modules quickly.

One new aspect to XP is paired programming, where two programmers work together constantly. Generally, one is the lead programmer and the other is responsible for testing, but the jobs can overlap and be defined by the team. Making testing a key element of programming is an important part of XP. However, paired programming is seen by many as an inefficient use of resources. The second programmer is often a less experienced developer and can slow down an experienced developer. Besides, it can be more efficient to have one person test large sections of code at a time, instead of multiple people testing separate pieces.

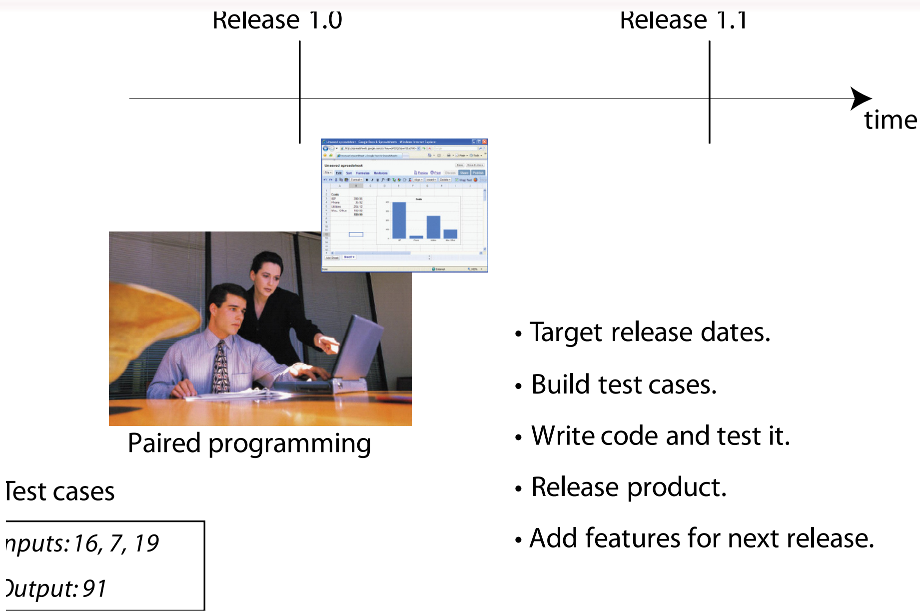


Figure 12.19

Extreme programming. Set target release dates and build test cases so you know when modules work. Use paired programming or other fast techniques to build modules and test them. Add features for next release.

One of the most challenging aspects to development is that there is a tremendous difference between individual programmers—in subject area knowledge, speed of programming, number of defects, and code maintainability. Some methodologies work well when an organization has top-notch developers, but fall apart in other companies. In choosing a methodology, managers must be aware of the capabilities of the individual programmers—and beware of turnover.

Developing Systems Requires Teamwork: JAD and RAD

Designing and developing systems is much easier if the entire system can be built by one person. In fact, that is one of the strengths of recent tools—they enable a single person to build more complex systems. However, many information systems, especially those that affect the entire organization, require teams of IS workers. As soon as multiple designers, analysts, and programmers are involved, everyone encounters management and communication problems. MIS researchers have measured the effects of these problems. One study by DeMarco and Lister showed that on large projects, 70 percent of a developer's time is spent working with others. Jones noted that team activities accounted for 85 percent of the development costs. There seem to be substantial areas for improvement in systems development by focusing on teamwork.

One of the most difficult steps in creating any new system is determining the user requirements. What does the system need to do and how will it work? This step is crucial. If the designers make a mistake here, the system will either be useless or will need expensive modifications later. Prototyping and SDLC take different approaches to this problem. With SDLC, analysts talk with users and write reports that describe how the system will operate. Users examine the reports and

Technology Toolbox: Programming a New Function in Excel

Problem: You need to add a tricky function to a spreadsheet.
Tools: Microsoft Office contains a language to create your own tools and functions.

```
Function BlackScholes(CallPut As String, StockPrice As Double,_
   ExercisePrice As Double,TimeLeft As Double, rate As Double, _
   volatility As Double) As Double
   Dim d1 As Double, d2 As Double
   d1 = (Math.Log(StockPrice / ExercisePrice) + _
      (rate + volatility ^ 2 / 2) * TimeLeft) / _
      (volatility * Math.Sqr(TimeLeft))
   d2 = d1 - volatility * Math.Sqr(TimeLeft)
   If (Left(CallPut, 1) = "c") Then
      BlackScholes = StockPrice _
      * Application.WorksheetFunction.NormSDist(d1) _
      - ExercisePrice * Exp(-rate * TimeLeft) _
      * Application.WorksheetFunction.NormSDist(d2)
   Else
      BlackScholes = ExercisePrice*Exp(-rate*TimeLeft) * _
      Application.WorksheetFunction.NormSDist(-d2)-StockPrice _
      * Application.WorksheetFunction.NormSDist(-d1)
    End If
End Function
```

Many programming languages exist for different jobs, but they all have similar features. The common tasks are (1) define variables and perform calculations, (2) create functions and subroutines, (3) use conditional (if) statements to make choices, (4) write loops to repeat steps, and (5) input and output data (to the spreadsheet in this case). You use these building blocks to build functions and applications.

A financial option is a contract that enables you to purchase (or sell) shares of stock in the future for a specified exercise price. The stock currently trades at some other price, so you are gambling the price will increase or decrease. The Black-Scholes equation from finance is often used to calculate a value for option prices.

You need a place to write your new function. Open a new worksheet. Choose Developer/Record Macro. Start recording, click a cell in the worksheet and stop recording. Now choose View Code and delete the Macro1 subroutine you created in Module1. Add the new BlackScholes function.

Return to the spreadsheet and enter some sample data for stock price (60), exercise price (65), time left (0.25), rate (0.08), and volatility (0.3). To determine the value of a call option, enter the formula: =BlackSholes("call", B2, B3, B4, B5, B6), where the cell values match the locations you put the sample data. The spreadsheet will call your new function and return the results.

stock price	60	call	2.133368
exercise price	65	put	5.846282
time left	0.25		
rate	0.08		
volatility	0.3		

Quick Quiz:

1. What does the statement If (Left(CallPut, 1) = "c") do in the code?
2. What security setting do you need for this function to work?
3. How can a function directly alter several cells in a spreadsheet?

Figure 12.20

Joint application design. Application design can be accelerated and simplified by putting key users and developers together for a few days. By focusing on the single project, everyone gets input and can reach a consensus in a shorter time.

make changes. This approach is time consuming and difficult for users because they only see paper notes of the proposed system. Prototyping overcomes some of the problems by letting users work with actual screens and reports. But use of prototyping is hard to expand beyond one or two users.

Some companies overcome the problems of SDLC by prototyping each input screen and report with one or two primary users. Once the main concepts have been designed, the analysts formalize the system and get approval from other users. The designs are then given to programmers to create with the traditional SDLC development methods.

Recall that an important reason for using SDLC is to obtain the views and agreement of many users. Using traditional interview methods and paper documentation, this process often takes several months. Each change has to be reexamined by other users, and disagreements have to be resolved.

A technique known as **joint application design (JAD)** was created to speed up the design stage. With JAD the main system is designed in an intense three- to five-day workshop. As shown in Figure 12.20, users, managers, and systems analysts participate in a series of intense meetings to design the inputs (data and screens) and outputs (reports) needed by the new system.

By putting all of the decision makers in one room at the same time, conflicts are identified and resolved faster. Users and managers gain a better understanding of the problems and limitations of technology. The resulting system has greater

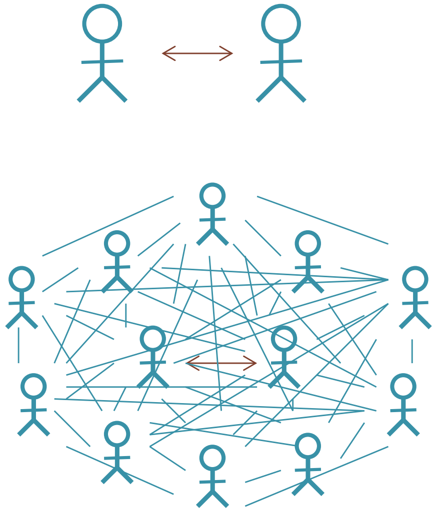


Figure 12.21

Communication. A project with two people has simple communication needs. Adding more users or more developers multiplies the number of potential communication problems. Different methodologies are used to handle and improve communication among the participants.

value for users and managers because it more closely matches their needs. There is less need for changes later, when they become more expensive, so the system is cheaper to create.

The biggest drawback to JAD is that it requires getting everyone together at the same time for an extended period of time. Even for moderately complex systems, the meetings can run eight hours a day for three to five days. Most managers (and users) find it difficult to be away from their jobs for that length of time. Higher-level managers are also needed at these meetings to ensure the system provides the appropriate reports and information. Finally, the meetings can succeed only if they are led by a trained facilitator. The facilitator keeps the discussions moving in the right direction, minimizes conflicts, and encourages everyone to participate. At the end of the sessions, the systems development team should have a complete description of the proposed system.

Rapid application development (RAD) applies the value of teamwork to the developers. By providing advanced development tools, prebuilt objects, and collaboration tools, some companies have found it is possible to reduce the overall development time. The key is to target steps that can overlap and be performed by multiple teams. By improving the collaboration tools, more steps can be compressed. Many e-commerce projects were developed with RAD techniques. Firms were concerned about being the first in the market and felt they needed to develop software rapidly. The goal of being first was later shown to be pointless, but the techniques of using small groups of programmers with advanced tools, collaboration, and intense programming sessions were relatively successful at quickly producing thousands of new applications.

Reality Bytes: Thousands of Apps not Much Money

In 2011, Google claimed that 450,000 developers had produced 200,000 applications for Android-based smart phones. In March, 2011, third-party counts estimated 250,000 Android apps versus 350,000 for Apple. But, the count quickly becomes meaningless—no one even has time to look at even a review of that many applications. Distimo, an analytics firm, noted that only 72,000 of the Android apps were sold for money; and of that list, only two had been downloaded more than 500,000 times worldwide. The company reported that of the iPhone's 211,000 paid apps, six were downloaded more than 500,000 times in April and May 2011. In terms of games, the most popular category, the Android market has five paid games downloaded more than 250,000 times and the iPhone has 10 paid games downloaded in the U.S. over two months. Of course, the iPhone has been sold for several more years than the Android phones. For developers and entrepreneurs, the point is that despite the potentially large market, very few smart phone applications make any money. In the Android market, 20 percent of all free apps and 80 percent of all paid apps were downloaded less than 100 times.

Adapted from Clint Boulton, "Android No Threat to Apple in Paid Apps," *eWeek*, May 29, 2011; and http://www.businessinsider.com/charts-of-the-week-ipad-competition-is-toast-2011-3#google-is-closing-the-gap-on-apples-app-store-3

Communication

Communication is a challenge in any project—but it is particularly critical in programming or systems development projects. Figure 12.21 shows the basic issue that as the number of participants increases, the need for communication multiplies. One of the key goals of a methodology is to define and improve the way that everyone communicates. Some formal systems, such as SDLC, define specific communication paths—often with a top-down approach where project managers produce daily or weekly statements. The figure also explains why adding people to a project slows it down. More people means more communication needs to take place.

Other methodologies work to reduce the communication needs by reducing the number of people—or by focusing the immediate communication needs among a smaller number of participants. For example, prototyping works because one developer works with one user, emphasizing the input and communication of that person. Extreme programming and modern tools work because they enable a single developer or small team to produce systems instead of relying on a large number of programmers. Even SDLC relies on reducing communication needs by emphasizing the importance of splitting a problem into smaller, independent pieces. Each piece can be developed by one person or a small team—without needing to see all of the details from every other programmer. The goal is to isolate the details and communicate only the formal interface connections.

Object-Oriented Design

Based on the value of OOP, it was natural for organizations to try and extend the concepts of objects to the entire design process. The goal is to define business objects that will apply to the entire organization. The objects would include the ability to retrieve data and perform standard functions. For instance, a Customer

Reality Bytes: Random Hacks of Kindness

Computer programmers can be expensive. Developing software requires training and creativity and demand for programmers is high, so it can be difficult for not-for-profit firms to hire or pay programmers. In 2009, Google, Yahoo!, the World Bank, NASA, and Microsoft created the "Random Hacks of Kindness" organization to encourage programmers and hackers to devote a weekend to helping find solutions to old problems and help not-for-profit organizations. In 2011 in Nairobi, developers stayed on site for 36 hours to develop programs to assist the Kenyan Red Cross manage volunteers. Another application helped people infected with HIV/AIDS stay on their medication during a disaster. An application created in Atlanta was similar to one built in Toronto. MessageCarrier can be used in a disaster to collect messages from people in remote areas without Internet or phone access. When the message phone is reconnected to the network, it will transfer all of the messages.

Adapted from Alden Mahler Levine, "'Brains Collide' During Hackathon for Climate Change, Disaster Relief," *CNN Online*, June 8, 2011.

object could be defined one time and stored in a central location. Whenever a programmer builds an application, the appropriate objects could be retrieved from the central store and pieced together to create the final application. With most of the work defined ahead of time, it would be easier and faster to build the application compared to starting from scratch each time.

Although the idea was sound, object-oriented design did not work very well in practice. Part of the problem is the necessity of defining all of the objects ahead of time. Most organizations are so busy trying to get basic tasks completed they do not have time to create objects that might be used someday. Another problem is that organizations change relatively quickly, often resulting in the need for new and modified objects. Finally, most big organizations simply decided to purchase ERP systems to integrate all of the organizations applications. The ERP systems use a DBMS to store data, and have internally-defined objects that can be used for custom programming. In a sense, the ERP systems solved the problem by pre-defining standard business objects that can be customized for any organization. But the initial development costs are borne by the ERP vendors and spread across thousands of customers. For any other application, OO design has generally been limited to single applications.

Open Source Development

Open source development is an interesting new method of developing complex software. With this approach, developers from virtually any company or location work on portions of the code. Usually, one person coordinates the efforts and identifies major changes and structure. The individual programmers write, debug, or test sections of code. If a programmer finds a better way to implement a function, the newer version is incorporated into the code. Hundreds or even thousands of programmers can contribute to the development of a project.

So far, this methodology has been used only to develop "free" software that is available for everyone's use. Many of the techniques were pioneered by Richard Stallman who developed emacs, a programmer's text editor. He later founded the GNU project (www.gnu.org) that uses the same methods to create and distribute tools and systems software. Linus Torvalds uses a similar approach to create and distribute the Linux operating system.

Open source development is interesting in terms of both the sophisticated software that has been created and the development methodology. Using Internet communications, and only a small team to coordinate and review the work, thousands of individuals have been able to work together to create complex software that rivals commercial products costing millions of dollars to create. In theory, similar techniques could be used to improve development within business. On the other hand, the technique requires the cooperation of hundreds of developers, often some of the best programmers in the world. It might be possible to hire these programmers on a freelance basis. A few companies offer Web sites that enable you to auction contracts for various portions of a programming job. But it is not entirely clear that this approach is cheaper than just hiring the best programmers.

Another issue with open source development also affects your decision about whether to use open source products such as Linux. How is the software going to be maintained and updated? Creating the initial software is only the first step. Bugs have to be fixed and new features added on a regular basis. As long as there is a core group of people willing to continue working on the project, these issues can be handled. Or if you have a staff with the skills to modify the software, you can make any changes you want—because you have the source code. But what happens 20 years later? Or even in the short run, can open source projects devote the time and money to usability testing and radical improvements as hardware changes? A commercial company has a financial incentive and the cash flow to keep products moving forward. Open source development has only the personal motivations of the prime organizer and the world developer community. Sometimes these motivations are enough to ensure the longevity of a product; sometimes they are not.

End-User Development

The term end user development simply means that users do all of the development work themselves. In many ways, it resembles prototyping, except that users (instead of analysts from the MIS department) create and modify the prototypes. Clearly the main advantage is that users get what they want without waiting for an MIS team to finish its other work and without the difficulty of trying to describe the business problems to someone else.

Two basic reasons explain why end-user development is increasingly popular. First, most MIS organizations are facing a two- or three-year backlog of projects. This means that if you bring a new project to MIS, the designers will not even start on it for at least two years (unless you give up some other project). The second reason is that software tools are getting more powerful and easier to use at the same time. Today it is possible for users to create systems with a spreadsheet in a few hours that 10 years ago would have taken MIS programmers a month to build with third-generation languages. As tools become more powerful and more integrated, it becomes possible to create even more complex systems. Think about some of the database and Web tools—such as PivotTables. Ten years ago, most users would not dream of being able to create these reports. Today, you can get reports and analyze data any way you want with a few clicks of the mouse. The advantages of end-user development are similar to those in prototyping. In particular, users get what they want, and they get working systems sooner.

The potential problems of end-user development are not always easy to see. Most of them arise from the fact that users generally lack the training and experience of MIS analysts and programmers. For instance, systems produced by end users tend to be written for only one person to use. They are oriented to working on stand-alone personal computers. The systems are often customized to fit the needs of the original users. Moreover, most users do not write documentation, so others will have difficulty using the products. Because of lack of training, users rarely perform as much testing as they should. The systems lack security controls and are hard to modify. Think about the problems you encounter when you are given a spreadsheet that was created by the person who held the job before you.

Other problems stem from the bottom-up approach inherent in end-user development. People in different areas of the company will wind up working on the same problem, when it could have been solved once by MIS. Data tends to be scattered throughout the company, making it hard to share and wasting space. Not following standards generates incompatibilities among systems, making it difficult to combine systems created by different departments or even by people within the same department.

End users are limited by the capabilities of commercial software. The initial systems may work fine, but as the company grows and changes, the commercial software might be unable to support the necessary changes. As a result, some users have created systems that produce incorrect answers, take too long to run, or lose data.

The last, and possibly most important, complication is that end-user development takes time away from the user's job. Some users spend months creating and modifying systems that might have been created by MIS programmers in a fraction of the time. One of the reasons for creating an MIS department is to gain efficiency from using specialists. If users are spending too much time creating and revising their own applications, the company needs to consider hiring more MIS personnel.

Development Summary

As a manager, one of the more difficult IT decisions you make is the choice of development methodology. As a business manager in a large organization, you might not have a vote. But within a smaller company, you will certainly have to look at the alternatives to help identify the most efficient means of creating projects. Even within a larger company, you might be in a position to suggest alternatives when price tags or time frames get too high.

Figure 12.22 summarizes the characteristics of the primary development methodologies. The chart is basically organized on a scale of formality. Large, formal projects are built using SDLC to control the development and record progress. Small scale reports and analyses can be created with end-user development. Prototyping is similar to end-user development, but is a step toward more control and formality because it uses trained MIS developers who follow established procedures and internal standards.

Remember that the various methodologies can be combined. For example, a JAD session might be used to define the initial goals and attributes of a large project. The forms might be refined through prototyping. But the overall project could be controlled through an SDLC project management system. Remember that each technology has different costs. SDLC provides the most control, but adds overhead costs that you have to recognize. On the other hand, prototyping

	SDLC	RAD	XP	JAD	Prototyping	End User
Control	Formal	MIS	Time	Joint	User	User
Time frame	Long	Short	Short	Medium	Short	Short
Users	Many	Few	Few	Few	One or two	One
MIS Staff	Many	Few	Many	Few	One or two	None
Trans/DSS	Trans.	Both	Both/DSS	DSS	DSS	DSS
Interface	Minimal	Minimal	Good	Crucial	Crucial	Crucial
Documentation, Training	Good	Limited	Variable	Limited	Weak	None
Integrity, Security	Vital	Vital	Unknown	Limited	Weak	Weak
Reusability	Limited	Some	Maybe	Limited	Weak	None

Figure 12.22

Comparison of methodologies. Each methodology has different strengths and weaknesses. You need to understand these differences so that you can choose the right tool for each project. Note that you can combine methodologies on large projects. For example, you could use prototyping to develop initial forms and reports that are incorporated into a larger SDLC project.

might appear to be inexpensive, but the costs could skyrocket if the project is never completed or requires huge amounts of developer and management time. One key issue in modern development is to identify these possible risks and threats up front. Then, each day, managers should evaluate the risks and see if the project has headed in the wrong direction. It might be impossible to prevent all risks, but at least if you are alert to the symptoms and recognize the problem earlier, you can correct it before the costs escalate and kill the project.

Process Analysis

How do you analyze and annotate a process-based system? If you are examining a transaction-processing system or dealing with a system that is largely noncomputerized, you should consider creating a process diagram. The purpose of a process diagram is to describe how the individual processes interact with each other. It concentrates on the business activities instead of the objects.

A data flow diagram is a process-oriented technique used for investigating information systems. The method can be used to look at the "big picture" and see how a system works in total. It also can be used to examine the details that occur within each process. Examining organizations at both levels provides a relatively complete picture of the problems and potential solutions. The use of systems analysis is illustrated by evaluating a small system for a zoo.

Input, Process, Output

One useful approach to systems is to look at them as a collection of processes or activities. The most important step in solving problems is to find the cause of the problems. Identifying the major processes in a system will help you under-

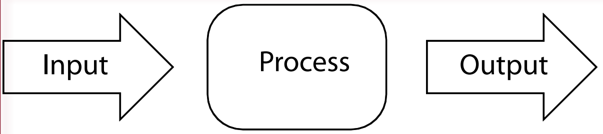


Figure 12.23

Each system can be decomposed into three major components: input, process, and output.

stand how the system works. Examining input and output objects helps you spot problems and trace them back to their source. As illustrated in Figure 12.23, systems receive *input*, which is *processed* to produce *output*. The process could be mechanical, such as manufacturing using raw materials, workers, and power. Alternatively, it might be a process involving symbolic processing instead of physical activity. For example, accounting systems receive sales data and process it into cash-flow statements. In many cases, there are two types of input and output: physical and data. Physical flows are often accompanied by data. For instance, raw materials are shipped with an invoice that describes the products and the shipping information. Systems theory can be used to examine both types of flow. However, this is an MIS text, so most of the problems presented here deal with flows of data.

Systems are described by collections of these processes. Each system operates in an environment that is somewhat arbitrarily defined by the boundaries of the system. For most problems, anything directly controlled by the firm is considered part of the relevant system. Everything else exists in the environment outside of the firm. The environment typically includes at least the physical space, laws, customs, industry, society, and country in which the firm operates. The firm can influence the physical environment, laws, and customs, but it does not have direct control over them.

Consider the example of a zoo: input and output are less concrete because a zoo primarily produces services instead of products. Figure 12.24 shows the basic inputs of food, money, and health data for potential new animals. Output objects include education, educational materials, and baby animals for other zoos. For most purposes, the system boundary is relatively clear. Visitors, suppliers, and other zoos are outside the direct control of the zoo, so they are in the environment. If the zoo was operated by a governmental agency, it would be harder to identify the boundary. Government systems tend to reach into many different areas, and it can be hard to identify their exact limits, especially since they can be extended or contracted by political decisions.

If a system is entirely self-contained and does not respond to changes in the environment, it is called a closed system. An open system learns by altering itself as the environment changes. Systems are almost never completely closed because closed systems cannot survive for long. However, some systems (or companies) are more responsive to changes in the environment than others.

Most large firms face a certain amount of inertia. It is easier for these firms to keep operating the way they always have than to continually introduce changes. But if a firm becomes too static, it can no longer respond to changes in the environment. Much like the U.S. railroad companies in the 1960s, closed firms will lose ground to firms that are more open and responsive to the environment. Re-

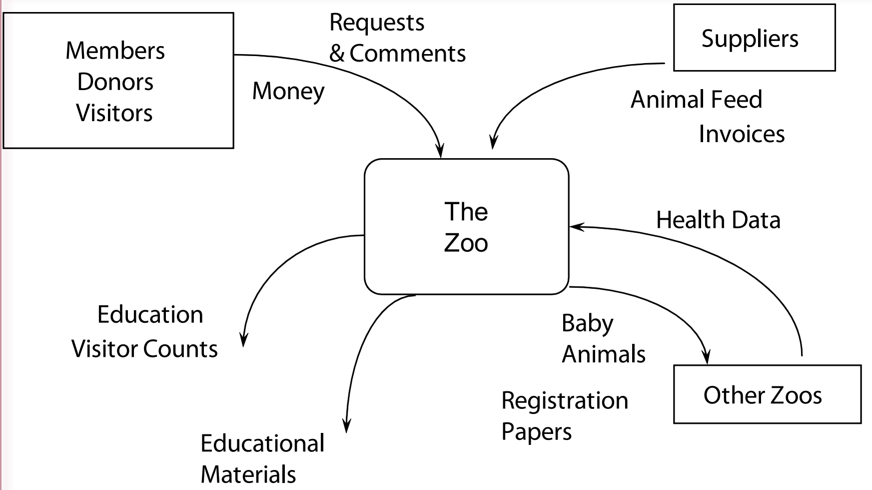


Figure 12.24

System boundary at the zoo. As we build systems, we must identify the components that make up the primary system. There will be many other entities that interact with the system. However, these entities are beyond our control, so they are outside of the system.

member that a key component of strategy is to search the environment for potential advantages.

Divide and Conquer

Most problems are too complex and too large to deal with all at once. Even if you could remember all the details, it would be hard to see how everything was supposed to fit together. A crucial step in analyzing a system is to carefully break it into smaller pieces or a collection of subsystems. Each subsystem is separate from the others, but they are connected and interdependent.

Figure 12.25 shows the five primary subsystems within the zoo. Of course, there could be many possible subsystems for the zoo. The actual division depends on how the organization operates. Each subsystem is defined by identifying the input and output flows. How do you know how to divide a system into smaller parts? Fortunately, most complex systems have already been subdivided into different departments and tasks. Many companies are organized by business functions: accounting, finance, human resources, marketing, MIS, and production. Others are split into divisions according to the type of product.

Once you have determined the major components of the system, each subsystem can be divided into even smaller pieces. An accounting department, for example, might be split into management reporting, tax management, quarterly reporting, and internal auditing groups. Each of these areas might be split into even more levels of detail. At each step, the subsystems are defined by what they do (process), what inputs are used, and what outputs are produced.

There are some drawbacks to the divide-and-conquer approach. It is crucial that you understand how the components work together. If a project is split into small parts and given to independent teams, the teams might lose sight of the

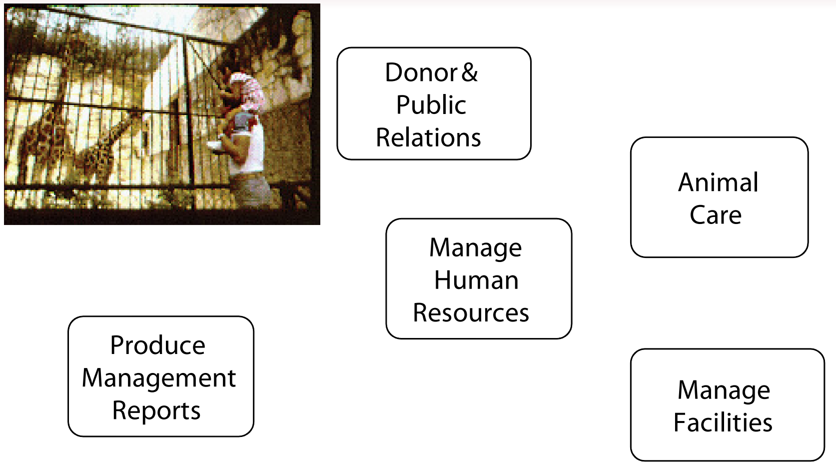


Figure 12.25

Primary subsystems of the zoo. The first step in analyzing a system is to identify the major subsystems. In most organizations, this step is relatively easy because the organization will consist of several departments or functions.

overall goals. Important components might not be completed, or the individual pieces might not meet the overall objectives of the system.

Goals and Objectives

Subsystems have goals or purposes. A goal of a manufacturing firm might be to sell more products than any rival (increasing sales). Or it might be to make as much money as possible for its owners (increasing revenues). Another goal might be to find an entirely new area in which to sell products (new market segments). The owners of the system should define its goals. If the system does not have a goal, it has no purpose and there is no way to evaluate it. In fact, by definition, it would not be a system. When you observe a system, you will need to evaluate performance, which means you have to identify the goals.

Typical spreadsheets give us the ability to ask “what-if?” questions. For example, you might want to know what happens if you increase sales commissions by 10 percent. Goals help focus the answer by providing the ability to ask *Why?* and *So what?* The answer to the *What-if?* question involving commissions might be that revenue increases by 5 percent. But what does that result mean? If we also know that a goal of the company is to increase profits, we could look more carefully and find that increasing commissions by 10 percent leads to a 3 percent increase in profits. That result is important because it brings the system closer to one of its goals. Hence, it would make sense to increase the commissions.

It is clear that to solve business problems, you must first identify the organization’s goals. The catch is that there are often conflicting ways to measure the goals. For instance, improved customer satisfaction or product quality might be useful goals. But how do we measure them? Managers who measure customer satisfaction by the number of complaints they receive will make different decisions than those who actively survey customers. In other words, the measurement of our performance with respect to the goals will depend on the data we collect.

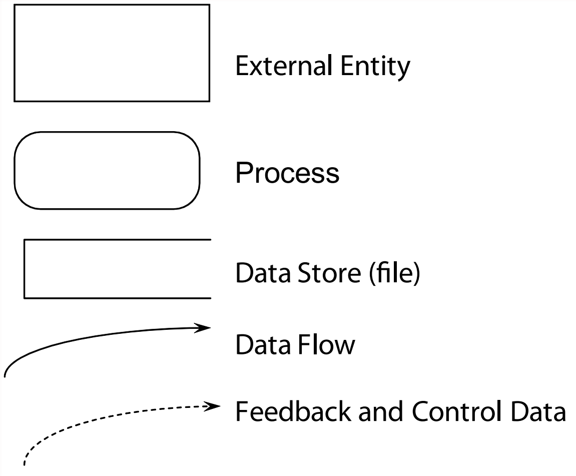


Figure 12.26

Only four or five objects are used to create a data flow diagram. External entities are objects that are independent and outside the system. Processes are functions and actions applied to data. A data store or file is a place to hold data. Data flows are shown as solid lines with arrows to indicate the data movement. Control flows are marked with dashed lines.

Diagramming Systems

We often represent systems graphically to gain insights and spot problems. We also use diagrams to communicate. Communication is of critical importance in MIS and all areas of business. Users describe their problems to systems analysts, who design improvements and describe them to programmers. Ideas and comments can be misinterpreted at any step. We can minimize problems by using a standard diagramming technique. The data flow diagram approach presented in this section is commonly used because it focuses on the logical components of the system and there are few rules to remember, so almost anyone can understand the diagrams.

Although you could invent your own diagramming technique, a method called a **data flow diagram (DFD)** has been developed to represent information systems. It is designed to show how a system is divided into smaller portions and to highlight the flow of data between those parts. Because there are only three graphical elements (five if you count the dashed control flows separately), it is an easy technique to learn. The DFD illustrates the systems topics in this chapter.

The basic elements of a DFD are external entities (objects), processes, data stores (files), and data flows that connect the other items. Each element is drawn differently, as shown in Figure 12.26. For example, data flows are shown as arrows. Feedback and control data are usually drawn as dashed lines to show that they have a special purpose.

Figure 12.27 presents the main level of subsystems for the zoo. Notice that it contains external entities, processes, and data flows. This level generally does not show data files or control flows. They can be incorporated in more detailed presentations.

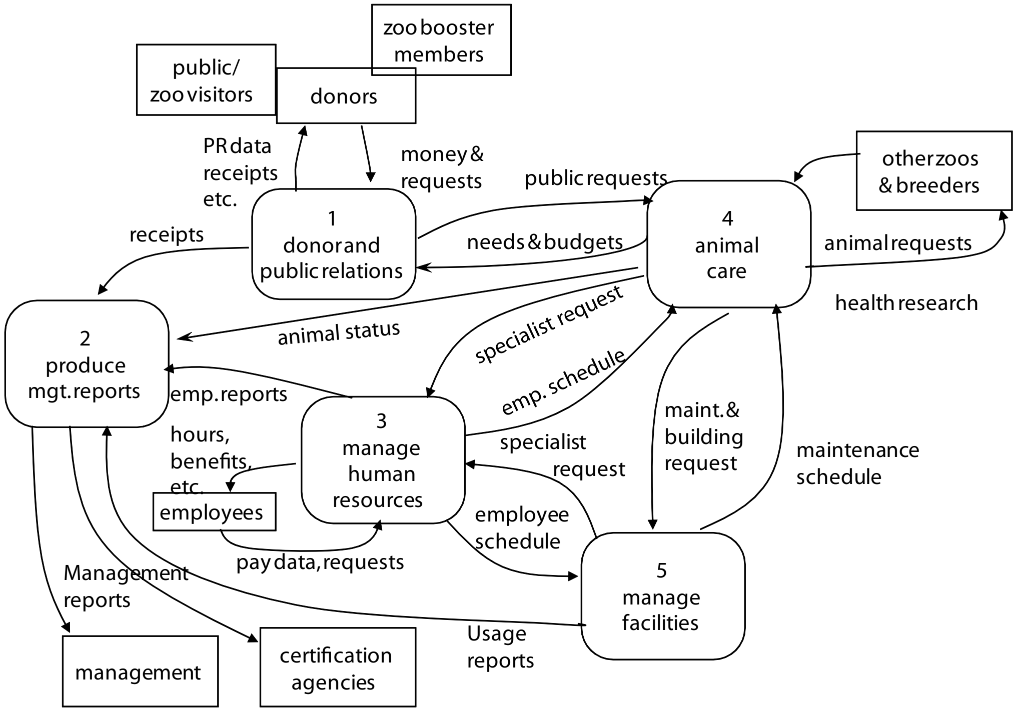


Figure 12.27

The zoo. The primary processes and data flows of the zoo.

External Entity

When you identify the boundary of a system, you will find some components in the environment that communicate with your system. They are called external entities. Although each situation is different, common examples include customers, suppliers, and management. External entities are objects, so they are labeled with nouns.

In the zoo example, the primary entities are management, certification agencies, other zoos, and members of the public (visitors, donors, and members). All relevant external entities need to be displayed on the first-level diagram.

Process

In a DFD, a process is an activity that involves data. Technically, DFDs are used to show systems that involve data, not products or other materials. However, in business today, virtually all physical processes have data-processing counterparts. When customers buy something, they get a receipt. In a manufacturing process, the amount of raw materials being put into a machine, measures of the volume of output, and quality control values are recorded. The DFD process is used to represent what happens to the data, not what occurs with the raw material.

Because processes represent actions, they are typically labeled with verbs, such as *sell products* or *create tax reports for management*. There are two important rules involving processes. First, a process cannot invent data. That means every process must have at least one flow of data entering it. Second, a process cannot be a black hole; every process must transfer data somewhere else. If you

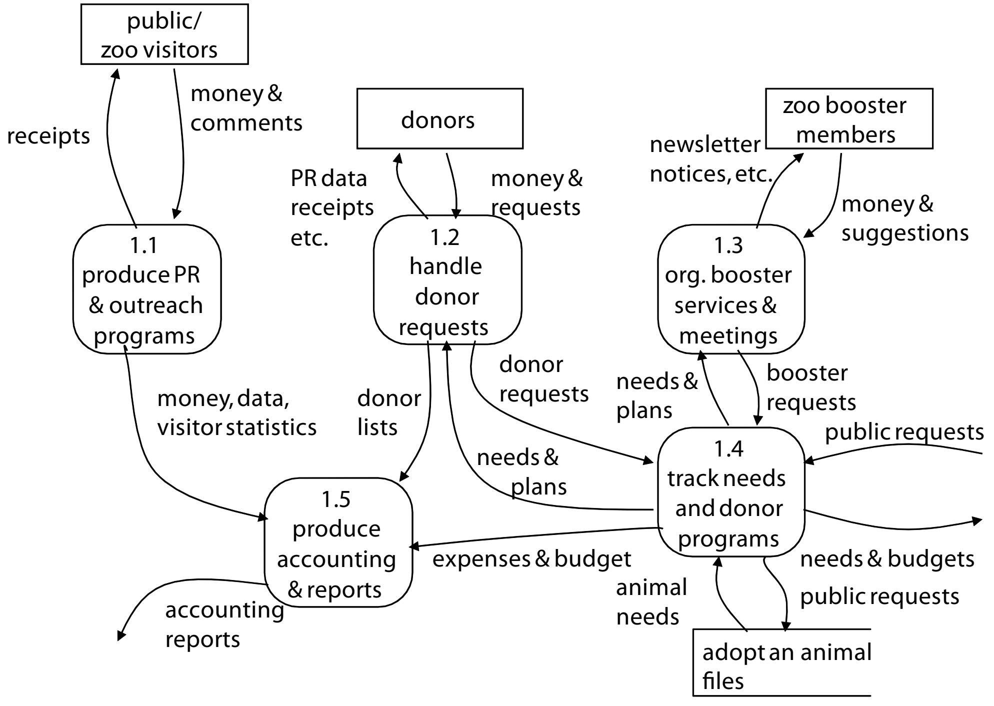


Figure 12.28

Each process can be expanded into more detail. This diagram shows the interactions with various members of the public. Note that data flows from the higher level must appear on this level.

look at your DFD and find one of these two problems, it usually means that you missed a connection between the processes. On the other hand, processes that do not export data might be data stores or external entities.

Data Store

A data store or file is simply a place to hold data for a length of time. It might be a filing cabinet, reference book, or computer file. In a computerized system, data is likely to be stored in a database management system (DBMS). Chapter 5 provides more detail on the capabilities and uses of a DBMS. For now, it is important to note that data is a valuable resource to any company. In drawing a DFD, try to list exactly what needs to be stored, how long it should be held, and who should be able to read or change the data.

Data Flow

The data flows represent the inputs and outputs of each process or subsystem. The data flows are easy to draw. They are simply arrows that connect processes, entities, and data stores. Be sure to label every data flow. The diagram might seem obvious *now*; however, if someone else reads it or you put it away for several months, it can be hard to figure out what each flow represents.

Processes	**Description . . .**
Animal care	Feed, clean, and vet care
Donor & public relations	Handle public requests and provide educational information
Employee relations	Schedule employees, process benefits, handle government reports
Facility management	Handle maintenance, new construction, planning
Produce mgt. reports	Collect data and produce summary reports for management
Entities	
Certification agencies	Government and private agencies that create rules and regulate zoos
Donors	People and companies who donate money to the zoo
Employees	Primary (paid) workers, full-time and part-time
Other zoos and breeders	Zoos we trade with and share data with
Public/zoo visitors	Daily visits, we rarely keep data on individuals
Zoo booster members	Members who donate money and time for minor benefits
Data	
Accounting reports	Standard (GAAS) accounting reports for management
Certification reports	Reports for certification agencies; produced annually
Facility reports	Summaries of work done and plans, mostly weekly
Needs and budgets	Budgets and special requests from animal care
Public requests	Suggestions and comments from the public

Figure 12.29

A few sample entries from the zoo's data dictionary. A data dictionary records details on all of the organization's objects. It is typically organized by type of object. It is easiest to maintain if it is stored in a computer database.

Division of the System

A DFD provides an excellent way to represent a system divided into smaller components. First, each task is shown as a separate process. The data flows between the processes represent the inputs and outputs of each subsystem. Second, the DFD for a complex system would be too large to fit on one page. Hence, the DFD is displayed on different pages or levels. The top level, or *context diagram*, acts as a title page and displays the boundaries of the system and the external entities that interact with the system. The next level (level zero) shows the primary subsystems. Figure 12.26 is an example of a level zero diagram. Each of these processes is then exploded into another level that shows more detail. Figure 12.28 is the exploded detail for the first process (donor and public relations). These explosions can continue to any depth until you have displayed all the detailed operations needed to explain the system.

Data Dictionary

In any project, you need to remember additional pieces of information about each object. You might want to keep a sample report for a management tax report data flow, along with any deadlines that must be met. For data stores, you need to record information such as who controls it, who needs access to the data, how often it should be backed up, and what elements it contains.

A **data dictionary**, or repository, contains all of the information that explains the terms you used to describe your system. A good computer-aided software engineering (CASE) tool will maintain the dictionary automatically and help you enter longer descriptions for each item. Without these tools, you will have to keep a notebook that contains the full descriptions. For convenience, the entries should be sorted alphabetically. A word processor can be used to hold and print the dictionary. Figure 12.29 shows sample entries for the zoo system.

Summary: How Do You Create a DFD?

The first step in creating a DFD is to identify the environment and boundaries of the system by asking the following questions: What problems do you need to solve? What areas do you want to avoid? What are the goals? What are the main external entities? The second step consists of identifying the primary processes that define the system. Keep the list short (fewer than 10). Then answer these questions: What are the main activities in the system? What are the inputs and outputs of each process? How are these processes interconnected by the data flows? The third step is to look at each process in more detail and draw an expanded subsystem on a new page. What activities take place within a given process? What detail is needed in the reports and data inputs? The fourth step is to build the control flows. What processes are used to monitor progress toward the goals? What additional data is collected to monitor the environment and the system's performance?

The key to analyzing systems is to start small. You can begin with one detailed subsystem and build your way up, or you can describe the general system processes and work down by adding increasing levels of detail.

Object-Oriented Design

How is object-oriented design different from process design?

One way to begin your analysis of a business is to focus on the business objects: what they are and what they do. Objects could be anything from people to raw materials to data files or schedules. The key to object-oriented design is to focus on defining what an object is and what it can do. A class is a generic description of a set of objects. This distinction is not crucial in this book, but you might want to know there is a difference. For example, the Bicycle class describes any bicycle that could be built by the company. A specific bicycle (e.g., serial number 15) is an object.

The concept of object-oriented design has received considerable attention during the past few years. In some ways, the base design techniques are not much different from traditional SDLC techniques. In other ways, object orientation requires a completely new way of thinking about systems development. The ultimate goal of the object-oriented approach is to build a set of reusable objects and procedures. The idea is that eventually, it should be possible to create new systems or modify old ones simply by plugging in a new module or modifying an existing object.

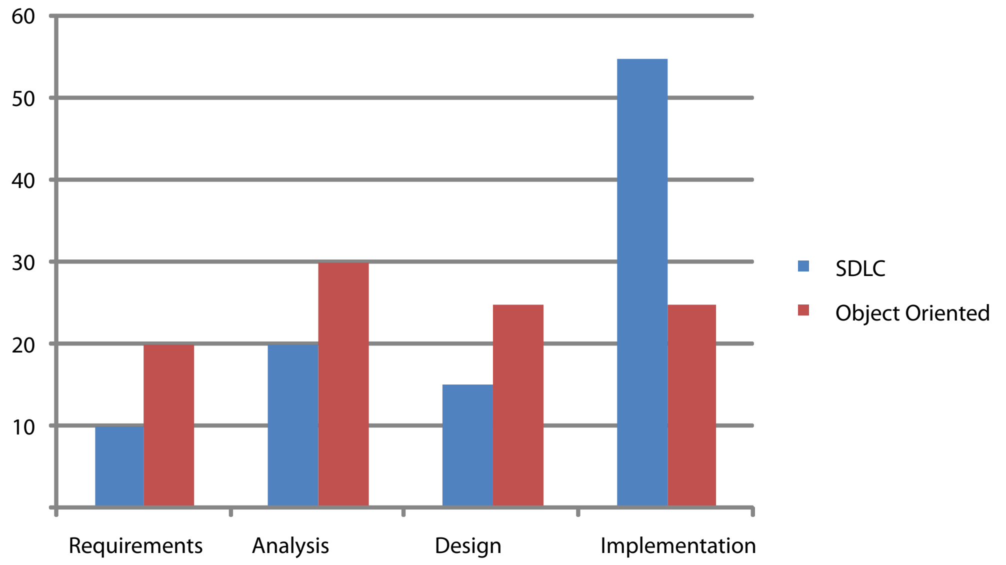


Figure 12.30

SDLC versus object oriented. Initial design of an object-oriented approach takes more effort than with an SDLC approach. However, once the objects are properly defined, it is much easier to create and implement a new system.

One key difference between object orientation and other development methods is the way processes or functions are handled. With objects, all functions are embedded in the definition of the object—the object comes first. The object approach reverses the treatment of processes and data. With SDLC, illustrated by a data flow diagram, the emphasis is on processes, and data (attributes) is passed between processes.

One goal of an object-oriented approach is to create a set of information system building blocks. These objects and procedures could be purchased from commercial software companies (such as a spreadsheet from Microsoft or a database system from Oracle). MIS programmers or consultants can create additional objects tailored for your specific company or department. Once the basic blocks are in place, end users or MIS analysts can select the individual pieces to create a complete system. Hence, as Figure 12.30 indicates, less time is needed for implementation, as long as the analysis and design are performed carefully. On the other hand, the up-front costs of designing and building these objects can be quite high. Furthermore, the tools and techniques tend to require substantial retraining of the existing MIS staff. Both of these types of costs have caused some companies to avoid object-oriented methods.

Distributed Services

Can software be located in multiple places? A major question in decentralization is where the software needs to be located. Substantial benefits arise from centralizing data—providing access across an intranet or the Internet. But users need some type of distributed hardware to access the data. Does that mean all of the software has to be installed on each machine? Some new technolo-

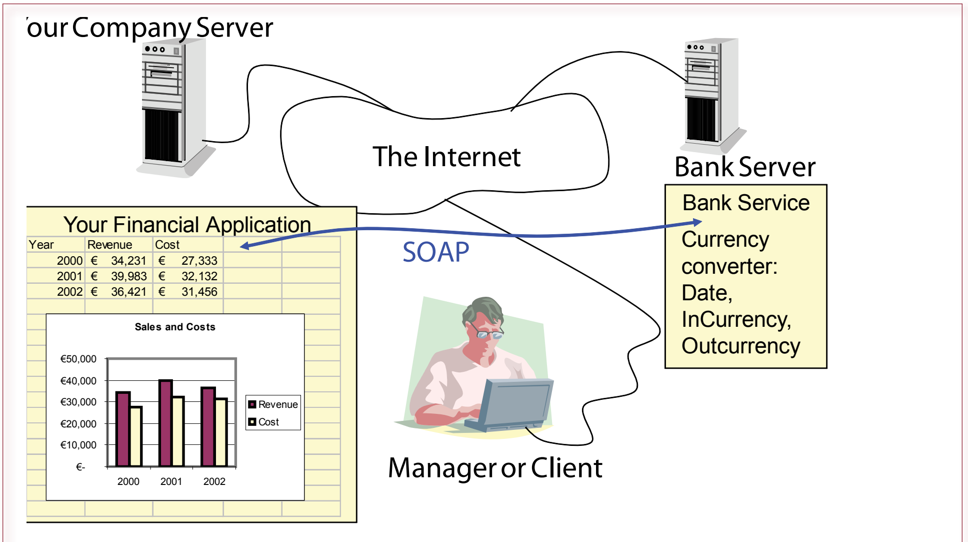


Figure 12.31

Simple object access protocol. SOAP enables firms to offer application object services that other firms can use across the Internet. In this example, your application can call the bank's currency converter object to get the correct exchange rates.

gies are being developed that provide support for distributing software functions across the network. While basic tools such as a word processor are still needed on individual machines, the complex business and analytical tools can be installed on central servers.

One of the primary technologies is the **simple object access protocol (SOAP)**. It is a standard being pushed by several vendors to define how objects can be used across the Internet. It relies heavily on the **extensible markup language (XML)** to transfer data between diverse computers. As a general manager, you do not need to know the details of how these two technologies work, but you should remember their purpose. Ultimately, you will want to select applications that fully support these standards so that you can build and use systems that work transparently across the Internet.

The purpose of SOAP is to enable firms to build application services that can be used by other organizations across the Internet. For instance, as shown in Figure 12.31, a bank (e.g., www.oanda.com) might offer a currency conversion application. Your company's accounting application could call the bank's program whenever it needed to convert money to a different currency.

Applications that use the SOAP and XML protocols can interact with other services across the Internet. However, a big question that remains to be resolved is how firms will price their services. Firms that create service objects will ultimately be able to bill clients a usage fee or a monthly charge with unlimited access. But a standardized billing mechanism has not been implemented yet.

Cloud Computing

How does cloud computing change software development? In one respect, cloud computing has made computing easier for companies. Essentially, cloud computing offers **software as a service (SaaS)**, where a few firms hire developers and create and host software and other firms simply lease the service. That means that only a few firms develop software. This trend has been evolving for several years—partly because new technologies make it feasible, but partly because most companies do not want to spend money and time trying to create custom software and pay large groups of programmers. The economics of software development also explain cloud computing because the high development costs are spread across many other companies. Still, not all companies are moving to publicly-run cloud computing. Issues of privacy and customization have held back some of the acceptance. Instead, smaller firms opt to buy software and install it on their central computers—and larger companies might run their own private clouds.

The second issue of cloud computing consists of developing software that runs on the cloud. First, most of the software relies on Internet technologies and databases. Initial technologies (Web browsers) provided limited support for interaction and usability. But, the Internet technologies continue to evolve, which provides more capabilities but requires learning and testing new tools and new designs. For instance, HTML 5 was introduced by Web browsers in 2011, with advanced interaction features, but the standard and full support are not expected for at least three years. Consequently, developing software for cloud computing remains somewhat experimental. Any experimental technology is more difficult to predict, and it is harder to estimate development time and cost. Also, it is harder to develop software that is designed to be used by multiple companies. Additional security elements need to be designed and tested, and the system has to be built to be scaled up as more companies use the products. Scalability and expansion are key elements in designing any cloud-based system. Not just the hardware, but the software and the administration tools have to be designed so they can be managed without significant increases in the number of administrators. Effectively, most cloud-based software carries additional development costs because administration tools need to be built into the system.

Summary

Systems development can be a difficult task. Many projects have failed because they cost much more than anticipated or they did not produce useful systems. Large projects are especially difficult to control because there can be conflicting goals, it is hard to ensure that subsystems work together, business needs change during the development process, and there is turnover among the MIS employees. The systems development life cycle evolved as a means to deal with the complexity of large systems and provide the necessary controls to keep projects on track.

Systems analysis techniques are used to break projects into manageable pieces. Various graphing tools, such as data flow diagrams, are used to display the relationships between the components. Systems design techniques use the results of the analysis to create the new system. The new system consists of interconnected modules. Each module has inputs, outputs, processing steps, database requirements, manual procedures, and controls. At various stages in the design process, managers and users are asked to sign off on the proposed system, indicating that they will accept it with no further changes.

In contrast to the rigid control embodied in the SDLC method, the prototyping approach is iterative and creates an early working model of the system. Users and managers can see the proposed input screens and reports and make changes to them. As the project develops, the prototype goes from a simple mockup to a working system. Prototyping is sometimes used in conjunction with SDLC during the design phase to lay out input screens and reports.

A third way to build systems is for end users to develop their own projects using fourth-generation tools such as database management systems, spreadsheets, and other commercial software. As the capabilities of commercial software tools increase, users can develop more complex systems. The backlog facing MIS also encourages users to develop their own systems. The potential dangers of user development, such as lack of testing, incompatibilities, and unnecessary duplication, can be controlled by having MIS teams available to assist end users.

All methods of developing systems involve five basic steps: feasibility and planning, systems analysis, design, implementation, and maintenance. Prototyping and end-user development typically focus on the design stage. However, managers need to remember that implementation problems can arise with any new system, regardless of how it was created. Similarly, there will always be a need to maintain and modify existing applications. It is easy to forget these steps when users develop their own software.

A Manager's View

As a manager in a large company, you will work closely with the MIS department to modify and build systems that support your operations. You need to be aware of the problems facing MIS staff to understand the reasons for their rules and methods. Managers are increasingly being asked to develop their own systems and to participate more heavily in the design of new reports and forms. The details of analysis, design, testing, and implementation will be useful regardless of the method used. As a manager, you also need to know the advantages and drawbacks of various development methods; you will often have to choose the method that is best suited to solving your problems.

Key Words

best practices
capability maturity model integration (CMMI)
change agents
commercial off-the-shelf software (COTS)
data dictionary
data flow diagram (DFD)
end-user development
event-driven
extensible markup language (XML)
extreme programming (XP)
fault tolerance
feasibility study
inheritance
joint application design (JAD)
object hierarchy
object-oriented programming (OOP)
open source development
outsourcing
phased implementation
program logic
prototyping
rapid application development (RAD)
reusability
scope creep
simple object access protocol (SOAP)
software as a service (SaaS)
software maintenance
syntax
systems analysis
systems analyst
systems development life cycle (SDLC

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Infoworld	www.infoworld.com
Internet.com	www.internet.com
PC World	www.pcworld.com
The Industry Standard	www.thestandard.com

Review Questions

1. What fundamental methods are available to build information systems?
2. What are the main elements of programming logic?
3. How does object inheritance simplify programming?
4. Explain why the first step in most business projects should never be programming.
5. What is the primary purpose of the systems development life cycle development methodology?

6. What are the main steps in the systems development life cycle methodology?
7. What drawbacks are created with the systems development life cycle methodology?
8. What alternative methods are being used to develop information systems?
9. How does agile or rapid application development speed up the development process?
10. What is the role of a data flow diagram in analyzing systems?
11. What are the main components of a data flow diagram?

Exercises

1. Interview a local manager to determine the requirements for a new system. Explain which method would be the best approach to develop the system. Estimate how long it would take to complete the project and how much it would cost. Advanced option: Illustrate the new system with a data flow or object-oriented diagram. More advanced: Create the system.
2. Create a Web page form with 5 text boxes and add Javascript code to check that each box is not empty when the form is submitted.
3. Find a small example of a business or Web program, choose a function or subroutine and explain its purpose.
4. A regional bank office generates loans for builders. The office has several bankers who form alliances with regional builders and negotiate loans and other services. The manager wants a system to track the leads, including the potential amount of the loan and the probability of the loan going through. Every month, the main office sends a spreadsheet file with current loan information. The manager and the main office want the regional bank officers to project the amount of money that will be loaned in the coming months. The manager wants a system to help collect and track this data. Identify the best development methodology. Assuming no one in the regional office has the skills to create the application, do some research to find at least two firms that could handle the job for a reasonable price.
5. A large lawn-maintenance company wants a new system that uses smart phone applications to collect data for its operations. The company has ten trucks and 20-30 people who mow lawns and other yard work for businesses and homes in a large city. To help reduce travel time and gas costs, the company wants to use GPS to track the daily routes of the 30 trucks and then later optimize the routes. It also wants to use this information to contact the nearest truck when a customer has a special request, or to direct the nearest truck to a new client who is requesting a quote. The phone application also needs a screen for employees to enter the time they spend on each project, and other screens to handle purchases of items such as gas, fertilizer, and tools. Maintenance for each of the mowers and other power tools should also be handled on the smart phone. Ideally, bar codes will be placed on each piece of equipment and the phone's camera can be used to scan the code to identify the equipment. The system also needs to support communication

between the workers and the clients. For instance, clients should be able to enter special requests, and workers can enter problems, such as broken sprinklers. Create a design for this application.

6. For each of the following information system projects, identify the development method that would be the best approach for most companies.
   a. An electronic system to handle travel requests and data entry for reimbursements.
   b. A smart phone app that is a cross between a map and a social network, where people enter locations of products they find in stores so other people can follow the map. (Where are the pickles in a Safeway store?)
   c. An application to use traffic cameras to track the location of specific cars using vision-recognition tools to follow license plates.
   d. A program to track health and feeding data at a zoo (for animals not visitors).
   e. An application for a couple of people in marketing to track viewings of radio and TV ads.
   f. Modifying an ERP system by adding forms, rules, and reports to track expenses related to a new product design team created from an acquisition.

7. Assume that you are on a project to build a new Web site for a midsize company. The firm sells materials to home builders—usually contractors, but some individual sales as well. The company wants to take orders over the Web and enable customers to track the status of current orders. Contractors also want the ability to look at old orders when placing new ones. For example, if they build the same style of house twice, they will need approximately the same materials. The manufacturer is not completely certain on many of the details yet, and you will have to interview customers to get additional details and feedback. Set up a schedule for developing this system using the SDLC approach. Then, identify ways that RAD might be used to reduce the overall development time.

8. You work for a company that is increasingly asking employees to develop their own applications using Microsoft Office tools connected to the corporate database. This process has not been working very well, and employees are grumbling. But the company has decided it cannot afford to hire all of the MIS people that would be needed to develop all applications and reports within the MIS department. How can the company improve the process? What tools and capabilities should the company add?

9. Check out www.sourceforge.net. Briefly explain its purpose. Find two programs that might be useful to businesses.

10. After several decades of challenges building systems, improving tools, and new development methods, why are many IT projects still over budget and late?

Technology Toolbox

11. Write a short macro program in Excel that adds all of the numbers between the values in cell A1 and cell A2 and puts the result in cell A5. For example, if A1 = 1 and A2 = 5, then add 1 + 2 + 3 + 4 + 5 to get 15. *Hint*: You can read or write to a cell with the command Range("A1").
12. Write an Excel macro that looks at each item selected to see if any cells are blank. If any are blank, display a message notifying the user how many blank cells there are. (*Hint*: Use the IsEmpty function to test and the MsgBox command to display a message.)
13. Create a form in Microsoft Access (or Visual Studio). Place text boxes on the form for amount to borrow, interest rate, and number of months. Add a fourth text box to hold the resulting payment amount. Set the properties to format and name each of the boxes. Add a button to calculate and display the payment amount based on the entered data. Use the Pmt function to do the calculation.
14. Use InfoPath to create and publish the expense report form. If possible, save it to a SharePoint server. Enter sample data and save and submit the form. E-mail it to your instructor as your supervisor.
15. Talk with a manager or employee to identify internal forms and data that are collected. Make a list of at least 5 forms for a business that could benefit by using InfoPath.
16. Find a tool on the Web that could be used to create forms similar to InfoPath (but probably simpler), but runs on a Web browser and stores all the data on a Web site.

Teamwork

17. Interview computer users to determine how they feel about their current system. Do they like it? What are the major advantages and drawbacks? How long have they used it? When was it changed last? Are there changes users want to see? Are they willing to accept changes? How are relations with the MIS workers? Who initiates changes, users or MIS? If users proposed a new project, how long would it take for MIS to get to it (how long is the backlog)? Each team member should interview a different person (some users, some in MIS). Combine your results to get a picture of the entire company. Do users agree with each other? Does the MIS department agree with the users? Do they see the same problems? (*Hint*: If you do not have access to another company, you can always find computer users in the university.)
18. Choose one person in the team who has an interesting job. Create a data flow diagram for the job and organization. Be sure to label everything and provide a data dictionary.
19. Find a manager who needs a computer project completed or updated. Interview the person and record the comments and notes. Create a basic design for the system. Identify the best methodology to create the system. If possible, find someone to build the system.

20. Rolling Thunder Bicycles wants to create a new Web site to enable customers to build and order bicycles online. It should also enable customers to view the progress of the construction and make payments online. Assign a different development methodology to each person who will perform a basic design and argue why that method should be used for the project. Select one of the methodologies in the end.
21. Examine the sample pseudocode used to compute the total of a set of numbers. Choose at least two programming languages and assign team members to a specific language and find or write the code needed to compute the total in that language. Submit and comment on the differences in the languages. *Hint: The code does not need to run and you can skimp on the file and print statements.*
22. Create a simple form using InfoPath that collects at least three pieces of data such as name and e-mail address. Test the form by sending it to each person on the team. Collect the data in a spreadsheet or simple database table.
23. As an exercise in creativity, each person should write down a business or personal task that they would like to see computerized or available on smart phones. Consolidate the list and search the Web to see what tools already exist to handle the task.

Rolling Thunder Database

24. Rolling Thunder bicycles needs a new Web site to sell its custom bicycles. How should it be developed? What methodology could be used?
25. Using the help system and Web site description of Rolling Thunder, create a data flow diagram to show the main processes directly involved with the customers (taking orders, sending notices and bills, and receiving payments).
26. Rolling Thunder Bicycles needs a new system to generate and track electronic orders (EDI) to its suppliers. What methodology should be used to develop the system?
27. Assume that the managers of Rolling Thunder bicycles have decided to purchase and implement an enterprise resource planning system. You have been selected to help determine which system the company should purchase. Outline the steps you will have to perform to select a vendor.
28. Identify at least three information processing tasks at Rolling Thunder Bicycles that could be handled with InfoPath. Compare the benefits and drawbacks of using InfoPath versus adding new forms to the existing application.

Additional Reading

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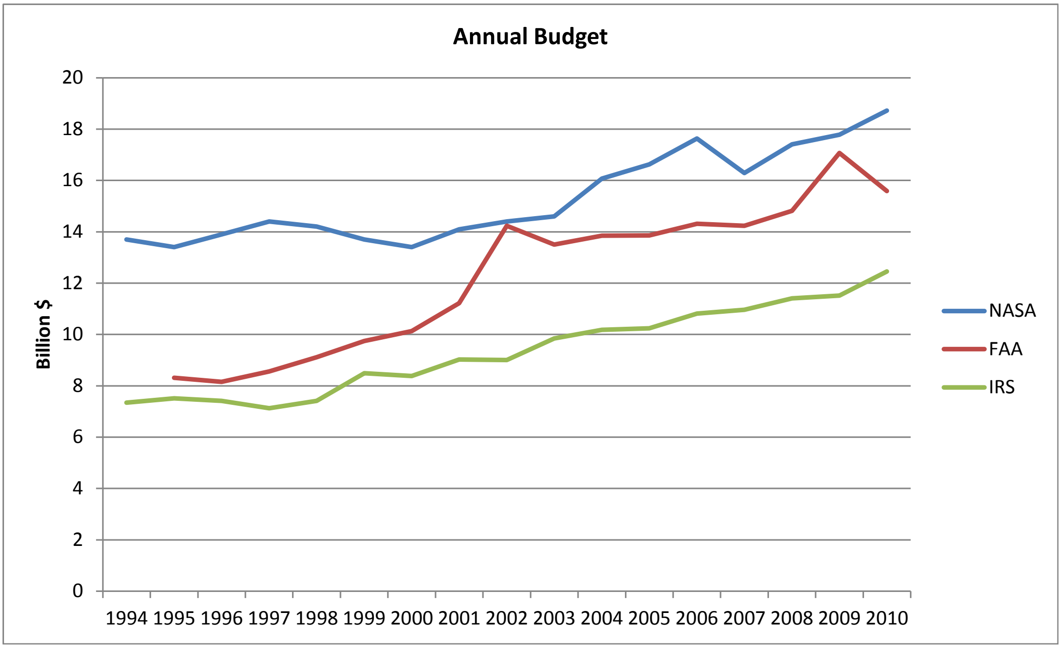
Cases: Government Agencies



Most U.S. citizens know the overall structure of the federal government: the president, Congress, and the Supreme Court. These groups are responsible for creating and interpreting the laws to govern the nation. What many people do not realize is that both the president and Congress are supported by a huge set of government agencies. These organizations form a bureaucracy that is ultimately responsible for carrying out the laws. Governmental agencies have several unique problems. The most important one is that funding is subject to changes in the political climate. With each election, an agency runs the risk of having to change direction, cancel projects, or provide support for new tasks.

On the other hand, most government agencies are not subject to economic pressures. Consequently, they have not been faced with the same incentives to economize and minimize costs that have faced businesses. Another critical feature of most government agencies is that they tend to serve large numbers of people, especially at the federal level. These large organizations collect huge amounts of data. Increasingly, these agencies are converting to electronic storage and access. Publicly available data can often be found on Web sites—at least at the federal level.

Most governmental agencies have dealt with the size issue by maintaining large staffs, and combining decentralized management with centralized controls. Traditionally, government organizations have paid lower salaries than commercial businesses. Although the salaries are supplemented with benefits and job security, governmental agencies often face high turnover rates and changes in personnel. To compensate for these problems, the agencies rely heavily on procedures. These rules seek to predict and then direct what to do in circumstances that may arise. As new situations and decisions present themselves, new rules are created. Given these challenges, there is no surprise that most people perceive government agencies as large bureaucracies, filled with endless forms and strange rules.

There are many obvious uses for computers in government agencies. During a few minutes of observation, anyone can generate ideas that could improve agency performance, making life easier for the workers and citizens. However, the real challenges have always come in creating and implementing these ideas. In the 2000s, the number of students graduating with degrees in computer science and information systems plummeted. As demand for technical skills began to increase in 2010, many companies found it difficult to find qualified new employees. This problem was even worse for government agencies—many of the top-notch, innovative programmers do not want to work for government agencies. Plus, many of the graduates of tech programs are not U.S. citizens, so they cannot get federal jobs (Piemonte 2011).

Although many success stories exist regarding computer implementation within government agencies, there are also some costly failures. The Federal Aviation Administration and the Internal Revenue Service cases present some of the difficulties that have arisen.

Be careful when you read these cases. Do not simply blame the problems on "typical government mismanagement." Many of these problems also exist within businesses. Always remember that the challenge is to search for and implement answers and methods that will overcome the obstacles and complications.

Size and Growth

The federal government employs 2 percent of the U.S. workforce, with about 2 million civilian employees in 2010, not counting the Postal Service. In 2003, it spent $757 billion, rising to 808 billion in 2006 and to $1.26 trillion in discretionary spending in 2010. With the tax cut of the early 2000s, federal receipts declined in 2002 and 2003, while expenditures continued to increase about 6 percent a year. The federal debt rose to 2.7 percent of GDP in 2003. Part of the economic balance is due to the war in Iraq; part is due to the attempts to prevent a major recession. In 2010, total federal government expenditures were $3.456 trillion, with receipts of $2.163 trillion, leaving an annual deficit of $1.293 trillion. To put it in context, expenditures amount to almost 24 percent of gross domestic product (GDP) for 2010. And budget projections for future years showed increasing expenses and deficits (2012 Federal Budget).

In some ways, the size of the federal government is shrinking. The number of elected officials remains constant but the rest of the federal government is downsizing. Federal government employment peaked in 1990 with a total number of 3.233 million employees. This number decreased through 2007 and increased in 2008, 2009, and probably 2010. In 2009, the total was 2,804 million. On the other hand, several widely circulated reports from most federal agencies indicate that by 2008, over 50 percent of the federal workforce will be eligible for retirement. Not all of them will actually retire immediately, but over the course of a few years, a substantial percentage of the federal workforce will need to be replaced. A considerable amount of internal knowledge could potentially be lost in the process. The Census Bureau reports that in 2007 excluding Postal Service employees, the Federal Government employed 1.845 million full-time civilians. In 2008, that number was 1.885 million and it dropped to 1.789 million in 2009.

In comparison, for the United Kingdom in 2003, public spending amounted to 41.1 percent of its GDP. Deficits in European nations routinely run about 5 percent of GDP (*The Economist* 2004). However, remember that the UK pays for health care. In the United States, if you include state and local government spending, total government spending was over $2 trillion in 2003 or 18.7 percent of GDP. If you include current healthcare spending, the total would be about 35 percent of U.S. GDP.

Information Technology

Like any business, government agencies increasingly rely on technology to improve productivity. Most agencies are under constant pressure to reduce costs—often to the point of having their funding cut. In large agencies, such as the IRS and the FAA, monster technology projects are funded separately. Consequently, the agencies have often been able to obtain funds specifically set aside to acquire or build new systems.

Most tasks performed by government agencies are unique. As a result, they require custom-developed software. Since the projects are huge and involve a large number of users, they are difficult to develop. Throw in a few bureaucratic turf battles, and it is amazing that anything gets done. Unfortunately, the result has been that many agencies are operating with technology that is 10, 20, or more years out of date. These archaic systems create their own ongoing problems. The government cannot just stop what it is doing, throw the old systems away, and build new ones. Instead, most of the government IT workers keep the old systems running. So, who is going to build the new systems? And how do you obtain the detailed knowledge from the users and workers of the old systems? Then, how do you transfer all of the data and keep both systems updated and running while testing the new system? However, we know that information technology constantly changes. Somehow, agencies have to balance the costs against the capabilities of the new systems.

In December 2010, Vivek Kundra, the U.S. CIO established a policy called "cloud first" which told federal agencies to move at least three services to cloud computing within 18 months. The goal was to decrease costs and improve flexibility. Some agencies found it relatively easy to comply; others were focused on evaluating operating costs, security, and bandwidth needs. For example, the agency responsible for the American Recovery and Reinvestment Act of 2009 used Amazon's EC2 to run the Recovery.gov Web site for sharing data related to the Act and saved about $750,000 in the first year [Pratt 2011]. Likewise, the U.S. Treasury Department moved the Treasury.gov site to Amazon cloud services. For more secure operations, the Defense Information Systems Agency (DISA) and NASA have created their own cloud servers (RACE and Nebula) that can be used to host operations from other agencies. The General Services Administration (GSA) is defining standard contracts and schedules to make it easier for agencies to purchase cloud services from commercial vendors. In the meantime, any classified data is unlikely to be moved to commercial clouds.

Oversight

Congress is charged with appropriating all federal money and controlling spending. Yet members face an enormous bureaucracy, plus constant reelection worries to distract them. Consequently, the General Accounting Office (GAO) was created to help monitor the spending and procedures at the various agencies. As a nonpartisan office, the GAO is free to collect whatever data it wants from the agencies and yell at them as necessary. You can obtain GAO reports directly from www.gao.gov. The reports often contain detailed information on specific projects and audits. The agencies generally provide responses to GAO concerns within the report. These responses are always interesting because the agency director tiptoes a line. No one wants to accept all of the GAO criticisms (and look like there is no control), yet no one wants to totally disprove the GAO, because that would mean no more funding is needed.

Additional Reading

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Case: Federal Aviation Administration (FAA)

The FAA is charged with overseeing all public (nonmilitary) flight operations in the United States related to safety and access to the air. They establish safety criteria, issue licenses for pilots, and create air worthiness certificates for planes. They also operate the air traffic control system throughout the United States. Funding for the agency is generated through user fees and taxes on aircraft fuel, tires, and airline tickets. The FAA is an executive agency that operates under the budgetary control of the president. Appropriations and organizational structure for the agency are approved by the Congress.

The increase in air traffic in the United States has made air traffic control a complex issue. In 1990, 466 million passengers a year were flying on U.S. airlines. In 2002, the airlines carried 714 million paying passengers. With more airlines and more daily flights, the air traffic control system is dealing with more difficult problems every year. The busiest airports (Atlanta tops the list) cause even more complications—trying to schedule hundreds of flights per hour.

Traffic control is organized into three levels: nationwide U.S. airspace, 20 regional air traffic centers, and individual airports. Air traffic control operators at each airport have immediate control over takeoffs and landings. Regional operators watch traffic within their defined airspace. They "hand off" planes as they fly across the country into the next airspace. Systemwide control is provided by the Central Flow facilities located in Washington, D.C. The Central Flow managers examine traffic across the entire United States and resolve conflicts and problems that arise among regions. The 40 traffic management specialists plan each day in advance, devising alternative routings for aircraft that may be needed because of problems arising from snowstorms, accidents, and closed runways.

Early Systems and Ongoing Problems

The early traffic control system was built with hardware and software from Sperry-Rand/Univac, a computer company that was purchased in the mid-1980s by Burroughs, and now named Unisys. The airport-based traffic control computers were based on 256K bytes of main memory and performed 500,000 instructions per second. The original systems were installed in the early 1960s. The 20 regional centers had their own computers—IBM 9020 machines that were custom made for the FAA in the 1960s.

Air traffic controllers have been reporting problems with existing systems for years:

- In 1992, West Coast air traffic was delayed for several hours. An IBM 3083 at the regional station crashed. In the process, it removed the identification labels from the radar screens of controllers from Oregon to Los Angeles. The controllers switched to an older backup system but had to increase plane separation from the typical 3 miles to up to 20 miles. Pilots and controllers used radio communication and manually filed flight plans to compensate for this loss. Ron Wilson, a spokesman for the San Francisco airport, noted that although there were frequent disruptions, "the FAA computer failures generally don't last long, just long enough to screw things up."
- In Oakland, California, the controller screens fail an average of three times a month. When this happens, the controllers have only a few seconds to memorize the position, speed, course, altitude, and destination of the 12 planes they are typically directing. Then their screens go blank for at least 10 seconds. Sometimes when the screens come back online, they are missing critical data.
- Joel Willemssen, assistant director of the U.S. GAO's Information Management and Technology Division, reported that 70 percent of the 63 largest airports in the United States have experienced problems with blank or flickering computer screens. John Mazor, a spokesman for the Airline Pilots Association, notes the problems cause "delays, diversions, and—in the worst possible cases—accidents. It's not as dangerous as you might think, but it's not something you want to have happen to you."
- The Los Angeles basin region consists of 21 airports handling 6.5 million flights a year. The GAO notes that the FAA computers in the region have repeatedly suffered from the loss of critical data and slow responses because of the overload.
- In 2007, the FAA's National Airspace Data Interchange Network (NADIN) flight-planning system in Atlanta shut down for several hours, causing flight delays and cancellations across the East Coast. Investigators were unable to find the cause of the problem, but NADIN was scheduled for replacement in 2008 (Weiss 2007).

Improvements

In 1981, the FAA was given approval to upgrade to a comprehensively new computer system. New airports, such as Dallas-Fort Worth, and the deregulation of the airline industry in 1978 led to huge increases in air traffic. The $12 billion plan called for replacement of 12 major systems over the course of 12 years. An additional 80 smaller projects were included in the plan.

By 1990, only 1 of the 12 systems had been replaced and the project was $15 billion over the original budget. The one project that was completed was known as Host, because it called for replacement of the mainframe computers at the 20 regional control centers. IBM installed its 3083 mainframes on schedule but was $16 million over budget. The 3083s were technologically obsolete at the time they were installed because the newer IBM 3090-class machines had already replaced them over a year before.

The FAA has been criticized for a lack of oversight and control in developing new systems. In 1980, the Senate Appropriations committee noted that "the FAA has no ongoing, welldefined, and systematic management approach to evaluating software and operational cost, capacity, and performance of the current system to meet projected shortrange workloads." The General Accounting Office (GAO), the watchdog of Congress, echoed that sentiment several times later.

Advanced Automation System

One of the more visible components of the plan to refurbish the system is the Advanced Automation System (AAS). It was designed to provide updated tracking displays for the controllers. It was supposed to be completed by 1990, but at that time was delayed until 1993. The system was designed to use IBM RS-6000 computers to display flight information, schedules, and current location along with weather fronts. The color systems were to have higher resolution, be easier to read, and carry more information.

In 1994, an internal study of the AAS showed that the project was still two years behind schedule and probably would fall back another two years before completion. Up until that time, the project had cost $2.3 billion. It was estimated to eventually cost about $7 billion. David Hinson, FAA administrator, announced that he was replacing top managers on the project, dropping portions of uncompleted work, and demanding performance guarantees from the contractors. The Area Control Computer Complex was canceled at this time. It was designed to interconnect the host computers at the airport with those at the regional levels.

Global Positioning System (GPS)

GPS is a satellite-based navigation system that was developed by the Pentagon and previously available for use only in connection with military air travel. GPS allows pilots to navigate based on satellite signals instead of radar signals. It allows real-time flight planning for pilots. As more satellite technology becomes available, the integration of air traffic as well as weather information and other data communication will become a necessary technological step. Four-dimensional GPS readings—longitude, latitude, altitude, and time—enable an aircraft to come within a few feet of any given target. Encryption technology is currently in place to protect security in the transmission of the satellite messages.

In 2004, the FAA began testing GPS tracking for air traffic control in Alaska. Because of the vast rugged terrain, it would be impossible to put radar stations across Alaska. Moreover, the onboard GPS units can report position data every second, while radar hits a plane only once every six seconds. The ADS-B technology GPS systems connect through the Iridium satellite system (Jackson April 26, 2004).

Standard Terminal Automation Replacement System (STARS)

"STARS is the next big step in the FAA's comprehensive effort to upgrade air traffic control facilities across the nation. The new system will provide the platform for improvements to handle the ever-growing volume of air traffic safely and efficiently well into the 21st century," said FAA administrator David R. Hinson (Dorr 1996). STARS will standardize all air traffic control equipment at the 172 FAA facilities as well as the 199 Department of Defense facilities. STARS will supply new hardware and software to these facilities. The program will be a complete replacement for the aging systems currently in use.

The most important feature of the STARS system will be the ability to display transmissions. The Automated Radar Terminal System (ARTS) that is currently in place was developed in the 1970s and 1980s. The FAA believes that interim programs are limited in their ability to extend the ARTS life in the short term. It is generally accepted that this system does not have the capabilities to take air traffic into the next century. ARTS software contains various versions and languages that are very labor intensive as well as expensive to support.

The STARS program includes a commercial standard system that the FAA believes will be much cheaper and easier to maintain. A key feature is the ability to extend and advance the capacity of the system without reengineering the basic architecture. By building on commercially available hardware and software, the development time for the software will be reduced significantly. The resulting maintenance costs will also be lower than those associated with the current ARTS system.

By 2003, the STARS project was behind schedule by at least six years and millions of dollars. The system was supposed to be completed in 1998 for $12 million. But after more than six years of development the system was still not implemented (McCartney 2003). However, an initial version of the system was installed in Philadelphia in late 2002. The system gathers data from several radar systems on color displays. However, not everyone was happy with it. Controllers in El Paso noted that the system could not distinguish between planes sitting on the runway and trucks on a nearby highway (*CNN* November 17, 2002). In mid-2004, the FAA announced that it was ready to begin implementing the new system. The Phase I rollout would take place at airports with the oldest equipment and cost $1.4 billion. Nineteen of the fifty sites were online as of 2004. But, the last of the 50 airports were not scheduled to receive the new equipment until the end of 2007. There was no budget or schedule for the remaining 100 plus airports. In 2004, the GAO and inspector general urged the FAA to gain control over costs. The project was already seven years behind schedule and estimated costs had risen to $1.9 billion (Mosquera April 26, 2004).

Wide Area Augmentation System (WAAS)

The Wide Area Augmentation System is used in conjunction with GPS. Using a network of 36 ground stations to "distill" satellite GPS signals, WAAS will allow commercial aircraft to pinpoint a location within seven meters. With the use of WAAS/GPS, the FAA hopes it can close many of its ground control centers and allow pilots to fly more direct routes. Consolidated, these tools are projected to lead to the concept of free flight.

The WAAS system fell even further behind than the STARS project. The satellite-based system was pushed back by five years and the estimated costs were tripled (McCartney 2003).

Free Flight

Free flight is a consolidated goal toward which the FAA is working. Free flight would enable pilots to control their own navigation procedures. The pilot would use the WAAS and GPS systems for navigational purposes and choose their own routes, speed, and altitude. Ground support will be held to a minimum and would be most important when flights are in congested airport areas, when airplanes approach restricted airspace, or when safety is at stake.

Two principles that drive the free flight plan are the protected and the alert airspace zones. The sizes of these zones are determined based on aircraft speed, performance characteristics, communications, navigation, and surveillance equipment. The protected zone is the zone closest to the aircraft. No aircraft should overlap the protected zone of another aircraft. The alert zone is one that extends far beyond an aircraft's protected zone. The distance between planes will be monitored closely. If a plane touches another plane's protected zone, the pilots and the air traffic controllers will determine the course corrections that are needed. Under the free flight system, interference will be minimized until the alert zones collide.

Of course, after September 11, the issue of free flight is probably obsolete. The FAA and security agencies are even more interested in controlling and restricting flights. Nonetheless, the FAA and the GAO continue to investigate free flight options. A main step in the process is the Traffic Management Advisor. This software helps controllers efficiently regulate the space between airplanes as they arrive at airports. Under Phase I of the free flight program, five software tools are being tested at various sites. Phase II represents the expansion of the systems—if they work. One system, the User Request Evaluation Tool (URET), was deployed late, so it will require additional testing. It is designed to identify conflicts and respond to pilot requests for route changes. Another tool, the Final Approach Spacing Tool (FAST), has been abandoned because of risks found in testing. It was designed to assign runways and schedule landings (Langlois October 2001)

Some researchers note that reducing flight times will not be sufficient to speed up the system. Delays are also created by slow operations at the terminals, including refueling, baggage handling, and unscheduled gate changes. These researchers suggest that significant changes are needed to improve communications among airport terminals. One possibility is wireless PDAs carried by all personnel and updated by the airlines.

The September 11 attacks caused the FAA to delay implementing some aspects of the free flight (CPDLC) deployment. A major reason for the delay was due to the costs that would be imposed on the airlines. The FAA was also not ready to implement the new technologies (Vasishtha 2002)

Technology Innovations

The FAA has suffered through several failed projects over the years, including the Advanced Automation System (AAS) that was designed in the mid-1990s and thrown away in favor of the STARS project. The FAA also designed and implemented new radio communication technology. The goal was to transfer data by text, to reduce the use of voice communications. The Aircraft Monitory System (ACMS) was designed to collect data on the plane and send it to controllers. The Aircraft Communication Addressing and Reporting System (ACARS) was introduced to cut down on the use of spoken radio messages to transmit information to the ground. It was thought that if the flight crew could save time by transmitting data to the ground rather than conveying it by voice to the air traffic controllers, they would be better able to concentrate on flying the plane. ACARS directly interfaces with ACMS and sends and receives messages directly to and from the pilot. The pilot punches the message, such as flight plans, in an alphanumeric keypad or touch screen. Both systems operate on the Aeronautical Radio system (ARINC) that runs on VHF radio waves and handles the data transmission between the plane and the ground controllers. The system is owned and operated by the major airlines. The main drawback to ARINC is that because of limited bandwidth, the system transmits data at 2.4 kbps. In 2004, some airlines (notably Southwest) began installing a newer data service called VHF Digital Link Mode 2 (VDLM2), which can transmit data at rates up to 31.5 kbps (Brewin 2004).

Launched in 2003, the FAA budget for 2008 contained $175 million earmarked for the Next Generation Air Transportation System (NGATS). The system relies more on satellite (GPS) navigation. It also encourages airports to upgrade their facilities

Network

In 1998, the FAA replaced its mainframe-based system for acquisition management with a distributed architecture. The old system ran on 1980s-era minicomputers at 12 centers nationwide and processed more than 200,000 purchases per year. It was not updated for more than three years and was not Year 2000 ready. Mounting problems in the old system led many FAA officials to revert to paper to track agency purchases.

The new system is called Acquire. It uses Oracle Corporation's Alert software and the Discoverer/2000 querying tool. The FAA must also use Oracle Federal Purchasing software to get Acquire to run on a network that links headquarters to regional offices and field centers.

The FAA also began preparing a communications system overhaul aimed at readying the agency's infrastructure to meet the needs of the 21st century. The FAA Integrated Communications Systems for the 21st century (FICS-21) program is projected to cost an estimated $2.75 billion.

FICS-21 will provide ground-to-ground transmission switching and network management control for voice, data, and video communications. The new initiative will replace at least 11 major programs, including FAA-owned and leased networks. FAA FICS-21 program manager Jeff Yarnell says it is a good time to rebuild the FAA's telecommunications infrastructure because many telecommunications contracts expired at the turn of the century.

In 2004, the FAA finally began rolling out its new communication backbone. The new FTI system was installed at 27 facilities. Steve Dash, FAA telecom manager, said that the system is replacing five disparate networks. He noted that "it's the first phase. The backbone will tie together the major operation facilities" (Jackson January 26, 2004). Ultimately, the system will be connected to the other 5,000 FAA facilities and save $700 million in telecommunication costs over 15 years. Installation of the system was contracted to Harris at an estimated total cost of $3.5 billion. As much as possible, the system will use off-the-shelf networking and telecommunication products. The new FTI system fell more than a year behind schedule and in 2006 and 2007 the agency ended up paying for both systems simultaneously because they had to maintain the old one while transitioning to the new, incomplete system (Sternstein 2006).

The FAA also provides services to pilots (and the public) through its Web site. Pilots account for 30 percent of the site traffic. To provide faster service, the FAA installed an expert system from RightNow Technologies that examines questions posed by visitors. The software compares the question to answers that have been provided to other users. Matches that are close are immediately displayed to visitors. Other questions are forwarded to the appropriate FAA authorities. Greg Gianforte, CEO with RightNow comments that "we use a series of both implicit and explicit learning capabilities, which include artificial intelligence and machine learning, to observe the historical usefulness of each knowledge item and provide greater visibility to knowledge." Typically, the system can automatically handle 90 percent of the inquiries (Chourey April 26, 2004).

In conjunction with NASA, the FAA is using a simulation system called FutureFlight to test changes to airport control systems. Researchers testing configurations of the LAX airport found that safety could be improved by moving a taxiway to one end of the airport. John Bluck, speaking for the Ames Research Center, notes that "the idea is to try it [changes] in a safe way that's as close to reality as we can make it. You don't have to try something new on a real airport, where you have thousands of flights coming and going" (Langlois October 2001).

The Future

The FAA has faced considerable criticism over the delays and cost overruns associated with replacing its primary systems. The agency makes heavy use of outside contractors, which is probably a necessity. However, the agency needs to write better contracts so that it can maintain control over costs and schedules.

The successful implementation of STARS is becoming critical. Like other federal agencies, by 2014, as many as half of the air traffic controllers can retire (about 7,000 people) (Chourey July 5, 2004). These workers require intensive training, and their salaries represent a significant expense. In 2002, more than 1,000 controllers earned over $150,000 (McCartney 2003). The FAA is going to need better automated systems that are easier and safer. With increased traffic demands, the FAA will have to find a way to improve productivity.

In the 2008 budget year, the FAA is pushing for a new funding mechanism. In part led by the commercial airlines who are afraid of the microjet market, the FAA is trying to push for a cost-based user fee system. Direct fees to commercial carriers and fuel excise taxes collected from general aviation would be determined by the FAA using some unspecified process to match the fee to costs of the services provided to the two user groups. The FAA also wants the authority to levy additional fees for the most congested airports (2008 U.S. Budget). The agency claims that the NextGen project cannot be built without more funding. Planned for completion in 2025, the project is estimated to cost $15 to $22 billion (Bain 2007). In 2007, the FAA awarded an initial design contract to ConceptSolutions, LLC for a five-year $32 million project to design the NetGen system (Hardy 2007). The FAA claims the system is vital to increase flexibility and handle the anticipated 30 percent increase in flights. The 2012 proposed Federal budget called for $1.24 billion funding for NextGen, an increase of $370 million compared to 2010.

In 2000, Congress approved creating an internal manager to oversee the flight-control operations, but the position went empty for three years until the FAA hired Russell Chew in 2003. Coming from business, Mr. Chew has removed layers of bureaucracy, instituted cost measurement programs, and attempted to instill business management into the system. He ordered the first inventory of equipment ever conducted at the FAA. With measurements in place, the FAA determined that it cost $457 to handle one jet on one flight in 2003. With cost-cutting measures, he reduced the number to $440 in 2004. He has also tried to reduce costs, by urging for consolidation of facilities. But, Congress ultimately controls spending and representatives tend to fight plans that call for a reduction of jobs in their districts. Mr. Chew also faces resistance from other FAA managers. Marion Blakey, FAA Administrator observed that many FAA employees "see any kind of change as very threatening" (Meckler 2006).

The 2010 discretionary spending for the FAA was $12.478 billion. The fiscal year 2012 proposed budget calls for a slight increase to $12.883 billion. These numbers are on top of the mandatory spending of $3.515 billion in 2010 and proposed $2.424 billion in fiscal year 2012. The big challenge is that the FAA does not plan to fully replace the existing radar tracking system until at least 2025. In the meantime, problems still arise, such as the minor crash in 2011 when an Air

France Airbus A380 (a huge commercial airliner) collided with a regional CRJ-700 jet while taxiing at the JFK airport in New York. Bill Voss, former FAA air traffic development director and current president of the Flight Safety Foundation noted that "You'd be surprised—almost all of this is done with pieces of paper, an eyeball and a pencil. It is a very visual and manual activity." There were also a string of incidents (but not crashes) in 2011 when late-night traffic controllers were reported to be sleeping on the job (Patterson 2011). In terms of good news, most ocean flights controlled by the U.S., Canada, New Zealand, Australia, and most of Europe, are already monitored and controlled using a GPS system. The Advanced Technology and Oceanic Procedures (ATOP) system was adapted by Lockheed Martin from a system developed in New Zealand. After four years of use, with pilots and airlines defining their own routes, the system has saved nearly 10 million gallons of fuel. (McCartney 2009).

Questions

1. After 20 years, why is the FAA still having so many problems building new systems?
2. What tools or methodologies might be useful to help the FAA complete its remaining tasks?
3. Is it possible to speed up the NextGen schedule?
4. Will outside contractors (Computer Science Corporation) help the projects? How can you monitor and control the work by the contractors?

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Case: The Internal Revenue Service (IRS)

For the 2009 tax year, the IRS processed more than 144 million individual and 2.4 million corporate tax returns (www.IRS.gov/taxstats). Many of the returns are simple one-page forms; others run to thousands of pages of supporting documents. Overall, the service handles more than 1 billion information documents a year. The IRS processes more than $1 trillion in tax revenue a year. The IRS has 10 regional service centers that are responsible for processing and storing individual forms.

Until 1990, all documents at the IRS were stored as paper records in a central warehouse. In 1989, it cost the IRS $34 million just to store the paper documents. Documents were organized according to the year of filing. As a result, if a taxpayer had a problem or question that covered multiple years, the citizen had to schedule multiple meetings with IRS officials to correct problems for each of the years. In some cases, it could take weeks or months just to get the files. Occasionally, the IRS found it was faster to ask the taxpayer for a copy of the return. By the early 1990s, this problem was resolved by having each of the 10 service centers store digital images of the tax returns, making them available to agents on their terminals. While a step in the right direction, this approach did not give the IRS the flexibility it would receive from the ability to scan the returns directly into a computerized information system.

Automation sometimes causes problems in addition to solving them. Such was the case of Dickie Ann Conn. The IRS determined that she owed $67,714 in back taxes. She was sent a bill for more than $1 billion in interest and penalties. After being challenged, the IRS admitted that there was an error in the interest computation.

The IRS operating budget in 2010 was $12.146 billion, with a proposed fiscal year 2012 budget of $13.284 billion.

A *History of Automation Problems*

The IRS seems like a logical candidate for improved automation. The benefits of faster processing, fewer mistakes, and easier access to data ought to save a considerable amount of money. The computer's ability to search the data, automatically match transactions, and analyze each return presents several additional opportunities that can either cut costs or raise additional revenue. Managers at the IRS are fully aware of the potential, and they have proposed several systems over the years. The problem has been in implementation of the plans and in getting Congress to financially support the changes.

In the late 1960s, the IRS knew it needed to redesign its basic systems. In response, it began to plan for a system to be installed in the 1970s. The IRS did not get the needed support in Congress because of fears that it would be too expensive and too invasive into individual security and taxpayer privacy. As a result of this lack of support, the IRS turned its attention toward keeping its existing computers running.

In 1982, the existing system was nearing capacity and the IRS established the Tax System Redesign program. It promised a complete redesign of the system. According to the GAO, changes in management resulted in the system never getting past the design stage. A new assistant commissioner in 1982 embarked on the design of a new system that promised to carry the IRS through the 1990s. Initial costs were estimated at $3 billion to $5 billion over the entire project. The primary objective was to replace the old central tape-based system with an online database. Eventually, optical technology would be used to scan the original documents and store the data in the database. A new communication system would carry the data to any agent's workstation. By 1989, initial planning had already cost the IRS more than $70 million, with no concrete proposal or results.

The main computer systems were replaced at the IRS service centers in 1985. The change in the systems was almost disastrous for the IRS. It delayed returns processing and led to delays in refunds that cost the IRS millions of dollars in interest payments. IRS employees worked overtime but still could not keep up. Rumors were flying that some employees were dumping returns to cut down their backlog. Because of the delays and backlogs, the IRS managed to audit only about half the usual number of returns on which it conducted audits.

In 1986, the IRS initiated a plan to provide 18,000 laptop computers to enable its field auditors to be more productive with its Automated Examination System (AES). Unfortunately, the service bought the Zenith laptops a full year before the software was ready. The system was written in Pascal and was delivered to agents in July 1986. It was designed to examine Form 1040 returns. The biggest drawback was that it used 18 different diskettes. This required agents to be constantly swapping disks. Based on the privatization directives from the Reagan administration, the system was subcontracted to outside developers. As IRS funding was cut, programmers with experience in Pascal were cut. This led the system to be rewritten in C.

A survey in 1988 revealed that 77 percent of the agents were dissatisfied with the software. Only 33 percent said that they used it. By 1989, the IRS revised the software and managed to reduce it to eight disks. By this time, the AES project was more than six years behind schedule and, according to the GAO, was $800 million over the original budget. The IRS originally anticipated that the AES would produce $16.2 billion in additional revenue over nine years by making agents more productive. The GAO disputed those numbers, noting that "the IRS has been unable to verify that the use of laptops has actually resulted in the examination of additional returns or increased tax revenues." In 1990, the White House cut the funding for the program from $110 million to $20 million.

In 1999, the IRS implemented a new network to connect computers throughout the organization. Twenty staffers were dedicated to the project and took four years to complete it. IBM's Tivoli software is a key tool to manage the 132,000 networked devices in 87 locations. The software enables network managers to continually monitor all aspects of the network. They can also push changes down to the desktop computers if problems arise or they need upgrades. Before the system was available, it took an IRS staff member 20 minutes to update each device. With Tivoli live in 2003, a single network administrator sent one update to 400 desktops in one minute. Jim Kennedy, program manager for enterprise systems management at the Austin, Texas, support center estimates that the system has saved $2.6 million in the first quarter alone (Dubie 2003).

Technology Innovations

By 1989, the IRS knew that it desperately needed to redesign its entire system for collecting taxes and processing information. In hearings before Congress, Senator David Pryor (D-Ark.) noted that the 1960s-era IRS computers were headed for a "train wreck" in the mid-1990s. The GAO estimated the total project would cost between $3 billion and $4 billion. The projected date for implementation slipped from 1995 to 1998.

The overall design for the Tax System Modernization program (TSM) called for a centralized online database, smaller departmental systems containing local information, and linkage through a nationwide network. Tax return data would be entered through a combination of electronic filing and optical scanners.

By 1991, the estimated cost of the plan had expanded to $8 billion. Although the IRS projected that the system would cut $6 billion in costs, the plan was rapidly attacked by members of Congress. Three studies of the TSM plan by the GAO were released in early 1991:

- The GAO was concerned that optical technology was not sufficiently advanced to perform the tasks demanded by the IRS. The GAO urged greater emphasis on electronic filing.

- The GAO was concerned that management issues such as transition planning, progress measurement, and accountability were not sufficiently addressed by the plan.
- The GAO and Senator John Glenn (D-Ohio) voiced concerns about data security and integrity.

GAO official Howard Rhile noted, "This is a serious omission in view of the fact that the IRS intends to allow public access… to some of its systems and because concerns over the security of taxpayer information helped doom the first [IRS] modernization effort in the late 1970s."

Despite these misgivings, the IRS was committed to the TSM plan. Fred Goldberg, IRS commissioner, agreed with the GAO findings but observed that

> *We have been running our business essentially the same way, using essentially the same computer and telecommunications systems design for 25 years. [Existing systems] will perform well and achieve incremental improvements for the next few years… Our best judgment is that [OCR] technology will be there when we need it, by the end of the decade.*

By 1992, the situation grew worse. Shirley Peterson, the new commissioner of Internal Revenue, stated at a congressional hearing that

> *Our systems are so antiquated that we cannot adequately serve the public. The potential for breakdown during the filing season greatly exceeds acceptable business risk…. Some components of these computers are so old and brittle that they literally crumble when removed for maintenance.*

In December 1991, the IRS awarded a 12-year, $300 million contract to TRW to help manage the process and provide planning and system integration services. The recommended system was ambitious. It called for 60 major projects, two dozen major purchases, 20 million lines of new software, and 308 people just to manage the purchasing process. Despite the best efforts of the administrators, elements of the IRS modernization plan were stalled because of purchasing difficulties. In July 1991, the IRS awarded a billion-dollar Treasury Multiuser Acquisition Contract (TMAC) to AT&T. The goal was to standardize purchasing for the IRS and the Treasury Department by routing all purchases through one vendor. The contract was challenged by other vendors and overturned. The contract was rebid and AT&T won the second time. IBM (one of the original protesters) again objected to the process, noting that the IBM bid of $708 million was less than the $1.4 billion bid by AT&T.

In 1993, the IRS acknowledged that the TSM Design Master Plan needed to be rewritten. In particular, it had to focus on business aspects instead of technology elements. To better coordinate technical planning with IRS needs, the agency established a research and development center funded by $78.5 million of federal money but run by the private sector. The center was responsible for providing technical assistance and strategic planning for the TSM. The IRS also established a high-level "architect office" to evaluate technologies and direct their proposed uses.

Throughout calendar year 1992, the IRS spent $800 million on TSM. In 1993, new IRS estimates indicated that TSM would cost $7.8 billion above the $15.5 billion needed to keep existing systems running. The new system was projected to generate $12.6 billion in total benefits by 2008 through reduced costs, increased collections, and interest savings. Moreover, the improved process was supposed to save taxpayers $5.4 billion and cut 1 billion hours from the collective time they needed to spend with the IRS.

In 1996, the IRS asked Congress for a $1.03 billion appropriation. This was a substantial increase over the $622 million it spent on automation in 1995. Hazel Edwards from the General Accounting Office noted, “After eight years and an investment of almost $2 billion, the IRS's progress toward its vision has been minimal.”

IRS Commissioner Margaret Milner Richardson denied the GAO claims. She noted, “I think we have made significant progress, not minimal progress… but we do know we can and must do more” (Birnbaum, 1998).

The IRS situation represented a dilemma for Congress. The IRS claims that the only way to make a system that works is to spend more money. The GAO has set forth that it is impossible to complete the entire project envisioned by the IRS. The GAO believes the IRS should, instead, concentrate on smaller, more focused projects that can be completed in a one- to two-year timeframe.

In 2001, Congress passed tax-cut legislation to stimulate the economy, and ordered the IRS to send “refund” checks to all taxpayers. It took several months to create and mail the tens of millions of checks, but most of them were correct. On the other hand, about 523,000 taxpayers received notices that they would be getting a check for the full refund amount, when they were actually eligible for only part of the refund. The mistake was attributed to a programmer error, and the final checks were correct; but some taxpayers were confused by the misleading letter.

Electronic Filing

The IRS introduced electronic filing in 1986, when 25,000 forms were filed electronically. By 1990, 4.2 million people filed for tax refunds electronically. In 1992, the number increased to 10 million filers. In 2003, 49 percent of the personal tax returns were filed electronically (www.irs.gov).

The primary target for electronic filing is the millions of individual taxpayers who are slated to receive refunds. To control the process and ensure that documents are properly filed, electronic filing is available only through authorized tax preparers. The IRS is deliberately avoiding providing access to individual taxpayers. As a result, taxpayers who use the system pay an additional charge to the preparer. However, the electronic filing system provides refunds within a few days.

Forms that have been electronically filed cost the IRS one-tenth the processing cost of paper forms. This approach also eliminates the cost of paper storage. The IRS notes that it is able to store 800,000 returns on one side of a 12-inch optical disk.

For taxpayers with easy returns, the IRS is simplifying the process even further. Short forms can now be filed over the telephone. In a 1992 pilot, 117,000 Ohio taxpayers filed for refunds using push-button phone calls. The system was expanded nationwide in 1994. The push-button system can be used only by taxpayers who are able to use the 1040EZ form. A replacement form (1040-TEL) must still be signed and filed with the IRS, along with the W-2 (withholding) statements.

In the 1998 IRS Restructuring and Reform Act, Congress required the IRS to encourage the use of electronic filing. The IRS has made it easier for people to file electronically—particularly for those who use computer software to compute their taxes. In 1998, about 20 percent of individuals filed electronically; in 2000 the number was 28 percent; in 2001 about 32 percent (45 million). The IRS goal is to increase this number to 80 percent by 2007 (Dorobek 2001). For the 2001 tax year (filing in early 2002), the IRS used the Digital Signature law to send PINs to several million taxpayers, enabling them to legally sign their tax forms electronically. However, the one important catch is that taxpayers who file electronically must pay an additional fee to do so. Hence, only those who receive refunds (about 70 percent of the filers) are interested in paying the fee, because it enables them to get their money faster. Most experts believe it is unlikely that the IRS will meet the congressional goal of 80 percent by 2007.

In 2009, the IRS noted that it cost $3.29 to process a paper return and only 19 cents to process one filed electronically (Saunders March 2011). In 2011, the IRS stopped mailing paper forms to people to encourage them to file electronically. For 2009, about 70 percent of the forms were filed electronically. But e-filing is least used by wealthy taxpayers, and they are the ones with the most complex returns. Some people with complex forms cannot file electronically. Other people are wary of turning over massive amounts of data to a third-party company to handle their taxes online and submit them to the IRS.

The Internet

In late 2001, the IRS announced plans to offer electronic payments by businesses over the Internet. A major portion of the money received by the IRS comes from withholdings collected by businesses. This money has to be forwarded to the IRS at regular intervals, so the IRS is trying to reduce handling costs by moving these transactions online. The Electronic Federal Tax Payment System (EFTPS) is a Web-based system that can also be used by small businesses and by taxpayers who make estimated quarterly payments. Using modern strong encryption technologies, the IRS is confident the system will be secure.

Relatively early in the dot-com and dot-gov restructuring, the IRS realized the importance of putting information on its Web site. In fact, a huge amount of information is available online. And that is a problem. In 2001, IRS executives were asked to search the site for common tax information. It generally took 20 or 30 clicks to find any piece of information. To improve its Web site, the IRS hired Gregory Carson in 2001, a designer from private industry who helped to launch the Priceline.com Web site.

The IRS also signed a contract with the consulting group Accenture to redesign the IRS Web sites. In 2001, the site received 80 million hits a day. Gregory Carson, director of electronic tax administration modernization at the IRS, notes that "the development of an intuitive, intentions-based design will make it considerably easier for taxpayers and tax preparers, who pull forms from the site, to obtain the information and documents they need to file tax returns." (Rosencrance August 2001) Accenture's goal is to make the site easier to use so that users can reach the desired information within three clicks. Furthermore, Accenture will be hosting the site on its servers.

In 2003, more people turned to the Internet to file their tax returns. Several companies provide online systems that automatically e-file the data with the IRS. A few offer free filing. In 2003, 3.4 million taxpayers used the Free File service. In total over 14 million people used their personal computers to e-file their taxes (Mosquera May 10, 2004).

Automated Under-Reporter (AUR)

The Automated Under-Reporter (AUR) is another component of the TSM. The AUR is a system designed to monitor returns and identify people who are most likely to underpay their taxes. The system was first installed in 1992 at the Ogden, Utah, regional center. The system pulls data from the service center's Unisys 1180 mainframe. The data is downloaded across a local area network to a Sequent Computer System S-81 minicomputer. From there the information is sent to one of 240 networked UNIX workstations on the employees' desks.

The system automatically matches distribution documents (such as 1099s and W-2s) with the filings of individual taxpayers. Mark Cox, assistant IRS commissioner for information systems development, noted that in trials with the AUR, "we've been able to cut down the rework of cases from 25 percent to less than 5 percent. We see this type of work enabling us to share in more of a connectivity mode" (Quindlen, 1991).

The system uses an Oracle database running SQL to match data from various sources. It also performs basic tax computation and helps agents send notices to taxpayers. Managers have noted that even though the new system has not improved the speed of the agents, it has cut down on the error rates. As agents become familiar with the system, productivity is expected to improve.

In 1991, the Ogden center processed 26 million tax returns and collected $100 billion in tax payments. It processed $9 billion in refunds. In 1992, it won the Presidential Award for Quality for improved tax processing by saving the government $11 million over five years.

In 2007, the IRS estimated that the compliance rate for individuals paying taxes on time was 86 percent—leading to an estimated $290 billion per year tax gap (based on 2001 data). President Bush argued (2008 U.S. Budget) that if this tax gap could be reduced, many programs could be funded without additional taxes. His budget for the IRS called for an additional $410 million for research, enforcement, technology, and taxpayer services to reduce this gap.

The Currency and Banking Retrieval System

In 1988, Congress passed a new law in an attempt to cut down on crime (notably drug dealing) and to provide leads to people who significantly underreport their income. Every cash transaction over $10,000 is required by federal law to be reported to the IRS on a Form 8300. The IRS created the Currency and Banking Retrieval System to match these forms against the filer's tax return. The system automatically identifies people who had large cash purchases but claimed little income. Because of a programming error, the system missed forms covering $15 million in cash transactions between 1989 and 1990.

The problem stemmed from the fact that the IRS used the same code number on the 8300 forms that it used on other cash transaction forms. The IRS later assigned separate codes for each form. When programmers wrote the new matching programs, they did not realize there were two codes for each transaction. The system was corrected in 1991. By 1992 it was used to process more than 1 million queries a year.

Jennie Stathis of the GAO noted there were additional problems with Form 8300. In particular, the filings were incomplete or contained incorrect taxpayer identification numbers. The IRS is developing software to enable businesses to verify the taxpayer ID numbers automatically before the customer completes the purchase.

Document Processing System (DPS) and Service Center Recognition/Image Processing System (SCRIPS)

In 1994, the IRS awarded a $1.3 billion contract to the IBM Federal Systems division to design a document processing system. The goal was that by the late 1990s, the system would convert virtually every tax return to a digital format. A day after the contract was awarded, IBM sold the Federal Systems division to Loral Corporation for $1.52 billion.

The 15-year systems integration contract was to have the system running online in 1996. The plan called for scanning incoming tax forms. Special software digitally removed the form layout and instructions, leaving just the taxpayer data. OCR software was to then convert the characters (including handwritten numbers) into computer data.

The system was scheduled for initial installation at the Austin, Texas, regional center in August 1995. Plans called for installing it at Ogden, Utah; Cincinnati, Ohio; Memphis, Tennessee; and Kansas City, Missouri, by 1998. Despite the popularity of electronic filing, the IRS still sees a need for the OCR system. The IRS received 222 million returns in 2003. Of those, 53 million were electronic.

SCRIPS was the first scanning project. Presented at a cost of $17 million, it was approved to cost $88 million when it was awarded in 1993 to Grumman Corporation's Data Systems unit. SCRIPS was designed to capture data from four simple IRS forms that are single-sided. SCRIPS was supposed to be an interim solution that would support the IRS until the Document Processing System (DPS) could be fully deployed. However, delays pushed back the delivery of the SCRIPS project. By the time it was declared finished, the project cost $200 million (Birnbaum 1998)

DPS was the second scanning project. It has a projected cost of $1.3 billion. Interestingly, Grumman Data Systems was the loser in the contest for the DPS contract. The IRS noted that Grumman failed a key technical test. When completed, DPS was quite complicated to use. In this program, the IRS developed nine separate databases, most of which could not communicate with each other.

In 1996, Art Gross, a veteran of the New York State revenue department, became the new IRS chief information officer. He stated that the IRS's computers didn't "work in the real world" and that its employees lacked the "intellectual capital" to transform them. When he arrived in 1996, the IRS's Year 2000 conversion project had a budget of $20 million and a staff of three; by 1998, it had grown to a $900 million project with 600 workers, many of them consultants (Birnbaum 1998).

Gross tried to get control of the system. He ended the DPS or "Bubble Machine" project as being over budget and behind schedule. With help from TRW, he devised a new top-to-bottom computer architecture. The architecture was built around a centralized database to coordinate information at the IRS.

When Charles Rossotti arrived as the new commissioner, he proposed an even more ambitious plan. In addition to Year 2000 changes, computer updates from the 1997 tax law, and the overall modernization, Rossotti proposed to restructure the entire organization. This proved to be too much for Gross, who resigned.

In 1998, Congress passed the Government Paperwork Elimination Act, part of which forces the IRS to move to more electronic transactions. Since then, the IRS has created electronic versions of its forms that can be downloaded from its servers. In 2001, the IRS signed a contract with ScanSoft Inc. for OmniPage Pro 11 for use in its federal tax offices around the nation. The goal is to convert the mass-es of paper files into electronic documents. Instead of taxpayer files, the system is designed more to convert internal forms and documents so that all employees will have immediate access to up-to-date forms and policies on the IRS intranet.

Customer Relationship Management

In late 2001, the IRS began installing customer relationship management (CRM) software that it purchased from PeopleSoft. A key element of the kinder, gentler approach is the ability to track customer issues. CRM software can collect all of the customer interactions into one location—making it easier for multiple agents to see the entire history of a particular problem. The system will also enable the agency to create Web portals for professional tax preparers, IRS employees, and taxpayers. The portals will securely provide individual information to these groups over the Web. In addition to faster service, the IRS hopes to reduce the costs of its call centers by moving more access online.

The IRS also developed the e-help system in 2002 to provide a central point for customer service. The system was designed to ensure service representatives provide consistent and accurate responses to customer questions. The Inspector General in 2007 reported that the system had made progress, but still needed improvement. Notably, the system lacked quality measures and procedures, including a failure to survey customer opinions and train employees. In a random sample of 19 employees, the Inspector found that none of them had completed required training. Michael Phillips, IRS deputy inspector general for audit noted that "ensuring assistors complete required training will be of greater important as the IRS moves forward with implementation of the next available technology" (Cranmer 2007).

Security Breaches

In 1983, Senator John Glenn (D-Ohio) released an IRS report indicating that 386 employees took advantage of "ineffective security controls" and looked through tax records of friends, neighbors, relatives, and celebrities at the Atlanta regional IRS office. Furthermore, five employees used the system to create fraudulent returns, triggering more than 200 false tax refunds. Additional investigations turned up more than 100 other IRS employees nationwide with unauthorized access to records. Glenn observed that the IRS investigation examined only one region and looked at only one of 56 methods that have been identified to compromise security. Glenn expressed the concern that "this is just the tip of a very large iceberg."

The IRS noted that the TSM program "greatly increases the risk of employee browsing, disclosure, and fraud," because of the online access to the centralized databases.

Margaret Richardson, commissioner of the Internal Revenue Service, noted that the system used by the perpetrators was 20 years old and was used by 56,000 employees. It met all federal security standards, including the use of passwords and limited access based on job descriptions. The IRS found the problems in Atlanta by examining records of database access from 1990 to 1993. Because the system generates 100 million transactions a month, the data is stored on magnetic tape, making it difficult to search.

In 1989, the IRS arrested Alan N. Scott, of West Roxbury, Massachusetts, for allegedly submitting 45 fraudulent returns via the new electronic filing system. The IRS claims Scott received more than $325,000 in refunds.

The IRS requires tax return preparers to fill out an application before it issues an access code. Scott apparently used a fake taxpayer ID number and lied on the application form to gain the access number. The IRS claims he then submitted false returns using bogus names and taxpayer ID numbers to get refund checks ranging from $3,000 to $23,000.

IRS officials noted that the electronic filings actually made it easier to identify the problem, because the computer could scan the data earlier than the data would have been scanned if it had been submitted by hand. Once the situation was identified, the IRS was able to immediately lock out further transactions from Mr. Scott's access number.

In May 2007, the Treasury Department's Inspector General reported that the IRS lost 490 computers between 2003 and 2006. Of these, 111 occurred within IRS offices. Most of the machines lacked encryption and strong passwords. The IRS has 100,000 employees and has issued 47,000 laptops. It was unable to identify the data that was lost because the agency has no records of what data was stored on the machines, but the audit report claims data was compromised for at least 2,300 taxpayers. Deputy inspector general Michael R. Phillips, stated that "we believe it is very likely a large number of the lost or stolen IRS computers contained similar unencrypted data. Employees did not follow encryption procedures because they were either unaware of security requirements, did so for their own convenience, or did not know their own personal data were considered sensitive. We also found other computer devices, such as flash drives, CDs, and DVDs, on which sensitive data were not always encrypted." An audit in 2003 reported similar problems, and the IRS has taken no action to change procedures (Gaudin 2007).

Modern Disasters

In 1998, the message in congressional hearings was to "Do something. Anything." The hearings into IRS dealings with the public revealed several problems within the IRS. They emphasized the negative perceptions the public has toward this important agency. After listening to these criticisms, the IRS eventually agreed to change some of its policies to improve its treatment of citizens. The 1998 IRS Restructuring and Reform Act was aimed at changing IRS attitudes and providing citizens with more control in the tax-collection process. Charles Rossotti, the new IRS commissioner, described the process of upgrading the vacuum tube-era technology as being similar to "rebuilding Manhattan while we're still living in it." The $7 billion agency has attempted the same gargantuan task of modernizing its computers for 25 years and continues to fail. The total cost in the 1990s alone has been projected to be nearly $4 billion (Birnbaum 1998).

In 2002, the system included 80 mainframes, 1,335 minicomputers, and 130,000 desktop boxes that were largely unable to communicate with each other. Before his appointment as commissioner of the IRS in November 1997, Rossotti served as chairman of the computer consulting firm American Management Systems. In early 1998, Arthur Gross, the chief technology officer, who drafted the latest modernization blueprint, resigned in frustration. Shortly thereafter, Tony Musick, the chief financial officer, resigned to become deputy CFO at the Commerce Department (Birnbaum 1998).

Unfortunately, the IRS has been even less successful at implementing new technologies. By 1998, nearly all of the earlier systems development efforts were canceled. In late 1998, the IRS signed a 15-year development contract with Computer Science Corporation (CSC) that was worth $5 billion. By contract, CSC is responsible for helping design new systems, indicating that the ultimate goal is still to be determined. Outside experts note that the contract does not necessarily solve all the IRS problems. The IRS must still deal with the contract management issues, which have proved difficult to the IRS in the past.

In 1999, the IRS launched yet another attempt to modernize its systems. The $8 billion Business Systems Modernization (Bizmo) program was supposed to replace the infrastructure and over 100 applications. A key element is to replace the Master File system—which is an ancient tape-based system that holds customer data that the IRS has been using for over 40 years. The system runs an archaic programming language with code written in 1962. The heart of the new system is the Customer Account Data Engine (CADE) designed to run on IBM's DB2 database system. As of 2004, the project is way over budget and years behind schedule. Even the system to process the simple 1040EZ form is three years late and $36.8 million over budget (Varon 2004).

The system design actually started out well. The IRS hired CSC as the prime contractor. But the IRS did not maintain control of the contract, and there are serious doubts that even CSC was capable of handling the complex project. Paul Cofoni, president of CSC's Federal Sector business, testified to the U.S. House Ways and Means Oversight Subcommittee that "I have never encountered a program of the size and complexity as the Business Systems Modernization program at the IRS" (Varon 2004). Several times, the IRS considered firing CSC, but kept deciding that it would not be cost effective. One of the problems is that the IRS is not providing sufficient oversight of CSC or the project. They originally planned a relatively hands-off approach to let the company use best practices in its development. The problem is that CSC needed the expertise of the IRS agents and IT workers. The other problem is that the IRS went through five CIOs in seven years. In the meantime, CSC has gone through four managers to lead the project.

The CADE system is an impressive piece of technology—if it ever works. Once the database is active, the IRS will use a customized version of the Sapiens eMerge rule-processing engine. Congressional tax laws are coded as business rules that the system applies to evaluate each tax return. The system includes an XML-based RulesScribe layer that handles changes and additions to the rules. The simplest 1040EZ tax form requires about 1,000 rules. Red Forman, associate IRS commissioner for business systems modernization, notes that "we are certain we will have tens of thousands of business rules once CADE rolls out, and that's just for individual filers" (Mosquera May 17, 2004).

In May 2003, Mark Everson was appointed IRS commissioner, and three weeks later, he appointed W. Todd Grams as the CIO. As of 2004, the project is nowhere near completion. The IRS and CSC have been repeatedly blasted by congressional reports. Relationships between CSC and the IRS are tense. CSC has been banned from participating in additional IRS projects (Perez 2004). On the other hand, in mid-2004, the FAA did hire CSC for up to $589 million to help build an enhanced Traffic Flow Management system (McDougall 2004).

In 2006, the IRS issued more than $318 million in refunds on phony returns because of a software failure. The IRS planned to replace the old screening system with a Web-based application by January 2006, but the organization spent $20.5 million with no progress being developed by CSC. The IRS tried to restore the old application, but could not get it running in time. In 2005, the software caught 133,000 fake returns, stopping $412 million in refund checks from being sent.

Without the software, the IRS halted a mere $94 million in fraudulent refunds (Keizer 2006).

In 2007, the CADE system was operational, but not perfected. The IRS intends to use system in conjunction with its 45-year old Master File system until 2012. In 2007, the GAO accused CADE's slow processing times or delaying refunds for millions of taxpayers by several days. The CADE system also significantly exceed costs again in 2006 (Mosquera 2007).

The IRS is trying to balance a fine line when auditing people, particularly small businesses. In 2011, the IRS started demanding that small businesses turn over not just the data but also the accounting software and complete electronic files. Most small businesses use simple off-the-shelf accounting systems that do not segregate data. Providing the information requested by the IRS means turning over all of their records, including customer data. Professionals such as physicians are concerned that the request would violate HIPAA rules about patient confidentiality. But, even non-healthcare businesspeople are concerned. Benson Goldstein, senior technical manager of taxation at the AICPA noted that Believe me, small businesses don't want the IRS calling their customers" (Saunders May 2011).

In a letter to accountants, the IRS claimed that the request was part of its "modernization" program. Chris Wagner, commissioner of the Small Business/Self-Employed Division, wrote that the audits require "unaltered metadata" so examiners can "properly consider the integrity and veracity of the electronic files." Put another way, the IRS believes that small businesses are responsible for 20 percent of the estimated $345 billion tax gap, and it wants to completely examine business records to find any "errors" and "inconsistencies."

The Future

In the meantime, the IRS still has to process taxes. So far, electronic filing is probably the only thing keeping the agency alive. Yet if anything goes wrong with the ancient Master File system, the IRS is dead in the water. The IRS, CSC, and IBM have no choice but to get CADE running correctly as soon as possible.

Talk to citizens about paying taxes and you get lots of interesting responses. Yet a critical feature of the system is that everyone has to believe that they are being treated fairly—meaning the same as everyone else. If people somehow perceived that millions of others are getting by without paying taxes, everyone will revolt. For years, since the 1980s, the IRS has relied on a relatively simple system to automatically scan returns and identify possible tax cheats. The problem is that the rules are based on data and an economy from 20 years ago. The system is no longer catching the real tax cheats. In 2002, the IRS began collecting new data and designing new rules to identify which returns should be scrutinized more carefully. With a 13 percent increase in tax returns and a 29 percent decline in the auditing staff since 1995, the IRS has to rely on automated systems to analyze the returns. Charles O. Rossotti, the IRS commissioner at the time, could not give details of the new rules but did note that "the fact is, people who make more than $100,000 pay more than 60 percent of the taxes, and we need to focus there" (Johnston 2002).

The electronic filing system is critical to improving productivity at the IRS. Without it, thousands of people have to enter data from the paper forms into the computer system. Yet, the existing system has several problems. Notably, it often rejects 1040 forms because of errors. The errors are anticipated, because people often make simple mistakes while entering data into their systems. The problem is that the IRS system tends to reply with cryptic messages that users have trouble decoding. The IRS is aware of the problems, but cannot decide how to fix them. Terry Lutes, associate chief information officer for information technology services, notes that they cannot decide whether to fix the existing system or build a new one. He asks, "It's a question of how much money do you spend on a system that's going to be a throwaway?" But the drawback to a new system is that optimistically, it would not be in place until 2010 (Olsen 2004).

To top off all of the operational problems, the IRS is being criticized by the GAO because of problems with its internal accounting procedures. The GAO has been nagging the IRS about problems with their financial management system for a decade. Of 100 recommendations from the 2003 audit, the IRS has implemented only 24. The IRS is planning to address many of the other problems with another part of its modernization system, the Integrated Financial System (Mosquera April 30, 2004).

The IRS reported (2008 U.S. Budget) that electronic filing has increased from 31 percent in 2001 to 54 percent in 2006. This trend simplifies data collection and processing at the IRS, but it probably has limits.

The IRS held preliminary negotiations with vendors to outsource management and maintenance of its 100,000 desktops, but canceled the plan in late 2006. The IRS also scaled back its separate plan to outsource the handling of paper returns to a contractor. IAP Worldwide Services ran two processing centers, the other five were rescheduled for transfer after the 2006 tax year (McDougall November 2006). However, formal dates for transfers were not scheduled.

In 2007, the IRS awarded a five-year, $9.6 million contract to General Dynamics to help manage the business systems modernization project. Although details were not provided, the role appears to be implementation-oriented instead of development (Hardy 2007).

The fiscal year 2012 budget calls for "modernizing the IRS to improve customer service and boost tax collections" (2012 Federal Budget). Most of the added money in the budget was allocated for "revenue-generating tax enforcement initiatives." Much of the budget discussion in Washington has revolved around the "tax gap," the amount of money currently being paid and the amount that Congress and the President believe people should be paying. The difference is the amount that some people and firms might be "underpaying" on their taxes. Conservatively, the president believes that better enforcement can generate $1.3 billion a year. Part of the increased enforcement has been geared towards U.S. citizens with off-shore accounts. The IRS has been pushing people to report all of their income from other countries. In fiscal year 2010, the IRS reported that it collected $57.60 billion through the enforcement division (www.irs.gov).

The IRS defined an IT Modernization plan in 2006 and 2007 (IRS 2007) that presents a five-year plan for improving service and enforcement. A key highlight of the problems is that many systems are based on the Master Files which were designed in the 1960s for slow computers. Most of the processing is still handled through weekly updates to the master files with programs and patches written over the course of three decades. The lack of flexibility makes it difficult to adapt to the ever-changing tax codes. On the negative side, the 2007 document notes that the BSM program proposed in 1999 could not be completed in the proposed 10-15 years because of "resource limitations." The new "plan" calls for incremental releases and leveraging existing systems. Most of the "plan" simply defined business domains and IT domains—essentially a restructuring of the IRS operations.

But, it crucially lacks any details of how the systems will be revised to support those operations. The plan does list dozens of "potential future projects" within each business domain. That is, projects that might be useful for compliance, but have not yet been designed. Interestingly, within the technical domains, converting to IPv6 seems to be an important priority. Most of the document is a laundry list of features and tasks that commercial organizations already perform.

Interestingly, the IRS Web site has links to its YouTube, Twitter, and Facebook pages. Most of the information is geared towards professional tax professionals, but the videos do contain basic information on tax related topics (IRS Web site/New Media).

Questions

1. What problems have been experienced by the IRS in developing its information systems?
2. How are these problems related to the service's systems development methodologies?
3. How is the IRS going to get more people to file electronically? Is there an upper limit?
4. Are there any ways to speed up the development of systems for the IRS? What would be the costs and risks?
5. Are the IRS's problems the result of technology or management difficulties?
6. Why was the IRS unable to manage and control the CSC contract? What can the managers do differently to get the projects finished?

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Case: National Aeronautics and Space Administration (NASA)

NASA has experienced some serious problems over the past decade and a half. Some have been due to software development errors, such as the 1999 Mars Polar Lander that failed because a programmer made a calculation in miles instead of meters. Systems as complex as the ones that NASA builds are bound to have problems and most people are willing to tolerate the problems. But it turns out that rocket science must be easy compared to accounting. NASA has an ongoing problem with budgets and monitoring expenditures.

For years, NASA has routinely run over budget on projects. For years, the GAO has criticized NASA for poor accounting practices. One of the problems has been the decentralized nature of NASA—with offices scattered across the country and around the world. The financial system relied on 10 separate systems—some still written in decades-old COBOL. NASA knew it had to fix the financial reporting system, so it contracted with SAP to install their R/3 system to create a new Integrated Financial Management Program (IFMP). However, NASA has a target date of 2007 for completing the conversion, and even that number seems optimistic (GAO November 2003).

In 2004, the real nature of the mess was highly publicized by *CFO Magazine*. The article was largely driven by a disclaimed opinion by PriceWaterhouseCoopers (PwC), NASA's financial auditor. In that statement, PwC revealed that NASA's bookkeeping was so bad, that they were unable to account for $565 billion in year-end adjustments. That is billions, not millions, of dollars. Patrick Ciganer, program executive officer for integrated financial management at NASA, explains that "we had people in each of the [10] NASA centers who knew they had to make the year-end adjustments. The problem was, they had never done them before. They had been trained, but in some cases, that was six or eight months before, and they did it wrong" (Frieswick May 2004). The data was so bad that PwC had no choice but to discredit the data and note that it could not be fixed. PwC later declined to bid for the right to audit NASA in the following year.

In echoes reminiscent of Parmalat's financial scandal, PwC also discovered that NASA was $2 billion short in its cash account with the Treasury Department. NASA's books claimed $2 billion that did not exist. After seven months, NASA CFO Gwendolyn Brown was still unable to find the missing money. In testimony before the House Subcommittee on Government Efficiency and Financial Management, she denied that the loss was the result of "fraud, waste, or abuse," but she had no clue about where the money went. Subcommittee chair Rep. Todd Platts (R-Pa.) retorted, "If my checkbook is off by 10 cents, I'll stay up all night until I find that 10 cents. Your checkbook is off by $2 billion" (Frieswick July 2004). Brown noted that the agency was going back and reconciling balances from 2000 onward. But it is unlikely that they will find the $2 billion. PwC found several other problems involving hundreds of millions of dollars and failure by NASA to follow its own procedures and those required by the government rules.

Decentralization is a huge source of NASA's problems. Each of the 10 centers (including Kennedy and Marshall space centers and the Glenn research center) is run independently, with separate financial systems and personnel. When Brown arrived, she attempted to integrate the financial procedures, noting, "I've told them that from now on, the agency will set policy, process, and procedure, and you, the centers, will do implementation. If we're going to be accountable and credible, that's what we have to do here" (Frieswick May 2004). One of the goals of the SAP implementation is to embed all of the central rules and consolidate the data so that all of the centers have to follow the same procedures. In particular, each center will have to reconcile its spending to the Treasury balances every month.

NASA has been extremely optimistic about implementation of the new IFMP system, or deliberately misleading—it can be hard to tell the difference. The GAO commented that "when NASA announced, in June 2003, that [the core financial] module was fully operational at each of its 10 centers, about two-thirds of the financial events or transaction types needed to carry out day-to-day operations and produce external financial reports had not been implemented in the module" (GAO November 2003). Many of the features that NASA claimed to implement had never been tested. The GAO was also concerned about NASA's lack of oversight of its contractors and its equipment. As of 2003, NASA planned to continue using manual journal entries to handle all transactions with respect to its $37 billion in property (GAO November 2003). About $11 billion of that equipment is located at contractor facilities, and NASA has almost no documentation or reports on the property.

Along the same lines, NASA is unable to apply costs to specific projects. In particular, the agency is supposed to report all costs of the International Space Station (ISS). In their 2003 report, NASA did not even list the ISS—allegedly an "editorial oversight." The GAO report indicates that the NASA system is incapable of correctly assigning costs to projects.

NASA has made several attempts to improve its accounting. The GAO notes that "NASA has made two efforts in the recent past to improve its financial management processes and systems but both of these efforts were eventually abandoned after spending a total of 12 years and a reported $180 million" (GAO November 2003). NASA is already over budget and behind schedule with the new IFMP system. The ERP system was originally budgeted at $982.7 million and is already $121.8 million over budget (Dizard 2004).

By 2006, NASA was still trying to implement the SAP software. The $1.1 billion Integrated Enterprise Management Program included a $116 million financials upgrade. But NASA's Office of the Inspector General found several flaws in the management and implementation of the program. It also found end-user resistance and data integration problems. End users have pointed out that the system is unnecessarily complex, does not integrate well with some existing software, and does not appear to be increasing productivity (Songini 2006).

The NASA discretionary expenditures for 2010 were $18.912 billion or about $187 million over budget. The agency anticipated exceeding the 2011 budget by about $500 million. But the fiscal year 2012 proposed budget was reduced to match the budget for 2010 or about $18.724 billion. Most of the budget was allocated to replacing or modernizing existing buildings. Most of the space programs had already been cut, and the president stressed cooperating with private agencies and foreign nations (Russia) to provide lift capacity to space.

NASA is working to build a next generation space-based telescope. Although complex projects are difficult to forecast and to manage, an independent review panel noted that mistakes by NASA management are likely to increase the costs by $1.5 billion. The final costs are likely to be near $6.5 billion for a project that can be launched in 2015 at the earliest (Harwood 2010). The main problem is that the project cost estimates were too low because the initial budget did not fully understand the project, and the budgets never contained enough money to cover the costs. Chris Scolese, an associate NASA administrator commented that "Our main goal right now is to strengthen the management, which we're doing, to strengthen the oversight, which we're doing, and develop a good, strong estimate that we can defend. We aren't in the business of cost overruns. We're taking this very, very seriously."

NASA IT has had problems with security. Of course, every hacker on the planet dreams of breaking into NASA computers. But, financial systems are equally important, both to monitor for external attacks and to ensure security for internal operations. In 2010, the Inspector General found that only 24 percent (7 or 29) systems had met Financial Information Security Management Act (FISMA) standards for annual testing. Only 52 percent (15 of 29) met the requirements for annual contingency plan testing. And only 2 of 5 of the external systems had been certified and accredited. The problems arose largely because NASA did not have an independent verification function for IT security—a common requirement in commercial sites. The CIO had purchased an information system in 2005 for $3 million to help with the security plan, but the implementation failed and the Agency is spending money for a replacement system.

Purchases

NASA purchases billions of dollars of supplies a year. Desktop computers and accessories are important items for most of the offices. In 1998, to simplify purchases, NASA signed a nine-year $1.3 billion deal with seven companies to provide server, desktop, communication equipment, and support services. The Outsourcing Desktop Initiative for NASA (ODIN) required the vendors to maintain inventory at each major site. The vendors created ODIN catalogs that listed all of the parts available. Some NASA sites required workers to order only from the catalogs; others allowed workers to find different deals. Normally, you would expect a centralized system to provide negotiated discounts and better prices. In this case, NASA agencies were able to save thousands of dollars by not using the catalogs. The Goddard Space Flight Center purchased 5,000 copies of antivirus software without using the catalogs and saved $200,000. In 2003, the agency decided to tell all divisions that they were not required to purchase from the catalogs (Cowley 2003). In 2006, NASA's basic budget was $14.5 billion (2008 U.S. Budget). In 2007, NASA awarded a new computer-purchase contract to HP. The contract covers desktops, Blade PCs, printers, and similar products and allows up to $5.6 billion in purchases. The contract stipulates that prices must be below the schedule prices in the U.S. General Services Administration (Singer 2007).

The Future

In terms of operations and projects, NASA is moving forward with new design ideas. In particular, NASA is working with Carnegie Mellon University on a major software dependability project. The goal is to create software that can tolerate hardware faults and security problems. These more intelligent systems would help prevent problems like those that affected the Mars Polar Lander (Thibodeau 2003).

NASA is also investing in tools to improve collaboration among researchers. Communication and information sharing have presented operational problems in the past. If everyone has the same data, it is easier to spot problems, as well as conduct new research. For the Mars rover mission, the Jet Propulsion Lab (JPL) installed the DocuShare content-management system from Xerox. Thousands of experts around the world have access to over 100,000 files. The system can handle up to 50 simultaneous projects and has search systems to help researchers find the data they need (Chourey June 2004).

NASA is also installing a new high-speed network to support operations. The system from Force10 Networks will support 10 gbps, making it possible to transfer huge files quickly. The data is carried on optical fibers. The high capacity is needed to handle even the local satellite data. Every day, NASA's 14 satellites in earth orbit transmit three terabytes of data (Chourey April 2004).

On June 20, 2004, NASA, along with the rest of the world, saw a new piece of the future: SpaceShipOne, designed and built by Burt Rutan, carried a man into space and back (Weil 2004). Partly to prove a point, partly to win the $10 million Ansari X Prize in October, the ship did one thing extremely well. It pointed out that it is possible to reach space on a budget of a paltry $30 million. It is not likely that Rutan's company, Scaled Composites, is going to compete with NASA anytime soon. However, it does indicate that something must be seriously wrong at NASA—when a civilian company can get to space on a budget that would not even be a round-off value in the money that NASA mysteriously loses each year.

The Space Shuttle program ended in the summer of 2011. NASA is part way through designing a new launch vehicle, but funding and direction are uncertain. Until a new system is developed, NASA will have to rely on Russian facilities to deliver people to the international space station or for other purposes. Older launch vehicles can still be used for satellite launches. Several private companies have begun developing launch capabilities, but most are currently limited to low-earth orbit. Given the federal budget crunch, and no agreement on long-term goals for NASA, the future looks somewhat bleak. On the other hand, maybe it will give NASA time to fix the computer systems.

Questions

1. How can an organization lose $2 billion?
2. Were the auditor problems ($565 billion) due to technology, management, individuals, or some other reason?
3. Will the new ERP system be completed? If it is, will it solve NASA's problems, particularly in terms of centralization?
4. How is NASA going to solve its problems with the development of mission software? Why is this such a challenging problem?
5. How can Congress get NASA to provide accurate progress information, and how can Congress determine if it is being told the truth?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 13

Organizing MIS Resources

Chapter Outline

What You Will Learn in This Chapter

- How is an MIS department managed?
- Is the MIS department doing a good job?
- What roles and tasks does the MIS department perform?
- What MIS jobs are available, and how much will it cost to hire IT employees?
- Do you really need to run all of the MIS operations yourself?
- Who should control IT resources?
- How can Internet technologies be used internally to centralize data but still support decentralized user access?
- Why is the MIS department involved in so many conflicts? How do you solve them?

ExxonMobil

How do you create and manage an information system when the organization has offices and people around the nation or around the world? ExxonMobil and several other companies faced this question with an additional twist. They had to combine systems from two huge companies when they merged. Mobil also had to extend its SpeedPass RFID payment technology to all of the new stations. That meant installing new networks and extending the information system. Ultimately, the answer by ExxonMobil was to combine the SAP systems used by both companies and run on a single, centralized system.

ChevronTexaco took a similar approach when those two companies merged. The new firm has relied on centralization to control technology and reduce costs.

Royal Dutch Petroleum (Shell) faces similar global issues. It has not been as effective at managing its information and financial systems. The company has experienced difficulties dealing with multiple contract employment agencies. The company's stock also took a beating when the company had to restate its accounts because it had misstated its oil reserves.

Introduction

How is an MIS department managed? What tasks are performed by the MIS department and how do these roles fit into the rest of the organization? What problems and issues will you have to handle as a manager? As implied in Figure 13.1, the question of how MIS fits within an organization is difficult, and the answers have been changing along with the technologies. As a non-IS manager, you will encounter many issues and decisions that are affected by the MIS structure. You should learn to recognize common problems and possible solutions so that you can minimize the effect of some of these problems. When you are evaluating the CIO, MIS, and the overall structure, remember one rule: The job of MIS is to help the organization and the other managers.

The capabilities of application software are impressive. Because of these tools, business people using personal computers are solving problems in a few hours that never would have been attempted ten years ago. With these powerful tools available to the average business person, it is easy to wonder why a company needs an MIS department. That is a good question, and the answers keep changing through the years.

MIS departments provide many important services. At the most basic level, the department is charged with maintaining the networks and computer servers. With continual upgrades and evolving security threats, these tasks alone require considerable time and money. The MIS group is also responsible for maintaining the transaction processing systems including any ERP, accounting, and HRM systems. MIS workers also provide support for evaluating and buying new hardware and software and assisting users.

According to statistics collected by several consulting firms and IT magazines, large companies spend about 3-5 percent of their sales revenue on the MIS area. (See: http://www.metrics2.com/blog/2006/06/26/average_company_spends_34_of_revenue_on_it.html or http://uclue.com/?xq=1133) The level of technology spending varies by industry—with banking and telecommuni-

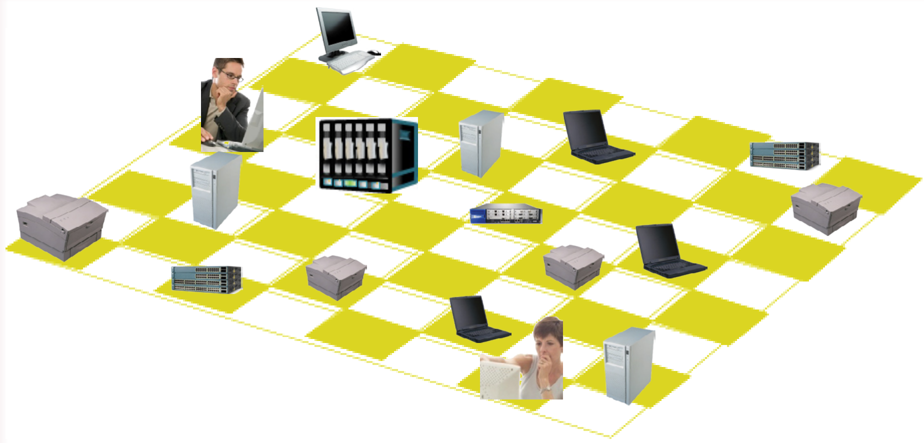

Figure 13.1

Organizing information system resources. Making effective use of information systems requires organizing the MIS resources: hardware, software, data, and personnel. A key decision involves positioning the resources in the organization which revolves around decentralization versus centralization. The goal is to balance the need for central control with the value of decentralized decisions.

cations firms at the top. For a company with a billion dollars in sales, that amounts to $50 million a year spent on MIS. This money pays for personal computers, central computers, communications, software, and MIS personnel to manage it all. The primary tasks undertaken by the MIS department are software development, setting corporate computing standards, hardware administration, database administration, advocacy and planning, and end-user support.

Small businesses rarely have a separate MIS department. That does not mean these duties are ignored. Even in small businesses, someone has to be responsible for these MIS functions. However, small businesses generally do not attempt to develop their own software. Even relying on commercial software requires that time be spent on determining data needs and evaluating software packages.

Probably the most important MIS decision facing business today is the issue of centralization. Because personal computers have a huge price/performance advantage over larger computers, there is a major incentive to decentralize the hardware. Yet there are some serious complications with complete decentralization. Several strategies for organizing information resources provide the advantages of both centralization and decentralization. The management goal is to find the combination that works best for each situation. Before examining the alternatives, you need to understand the basic MIS roles.

Managing the Information Systems Function

Is the MIS department doing a good job? Should the company be spending more money on MIS? Is it getting a good value for its current spending? Are there other methods that would be more efficient or save money? Many times in your career you will find yourself heavily involved with members of the MIS department. In the case of a small business, you might be in charge of the one or two MIS personnel. At some time, you might be the company liaison to an out-

Trends

In the early days, computers created few management issues. The large, expensive machines were placed in a central location and serviced by a centralized group of specialized employees. But as costs dropped over time, hardware spread throughout the organization. Soon, employees were collecting and creating data on hundreds or thousands of machines across the company. The local area networks of the late 1980s were installed in an effort to make it easier to share data and provide more centralized services. The initial spread of PCs and networks supported decentralization, where workers became responsible for handling their own data and computers.

Integrated packages (ERP), Web sites, and groupware tools make it easier to share data and support team work. These tools required corporatewide standards and began to encourage a recentralization of MIS resources. As companies periodically focus on cost control, the trade-offs between decentralization and centralization become a source of contention.

The increased attacks and renewed interest in security in the early 2000s generated additional interest in the management of information resources. Attempts to increase security led to even more demands for centralized control over resources. Centralized control and decentralized management are not necessarily good or bad. They both have strengths and weaknesses. The key is to find the appropriate balance for each organization. The challenge is that changes in technology and external events (such as security threats) sometimes cause organizations to leap to one solution without thinking about the consequences. Interesting arguments often follow.

sourcing vendor, MIS contractor, or consultant. In all of these situations, you will be responsible for planning, monitoring, and evaluating the MIS organization.

Management of information systems begins by understanding the roles of MIS. The MIS function is responsible for hardware and software acquisition and support. The MIS staff provide access to corporate data and build applications. They support end-user development with training and help desks. MIS workers set corporate data standards and maintain the integrity of the company databases. Some MIS organizations spend considerable resources developing and maintaining systems. All of these functions have to be organized, performed, and evaluated on a regular basis.

Managing Workers

Hiring, evaluating, and promoting workers are key issues in managing an IT department. MIS employees are relatively scarce and their salaries are often higher than other disciplines. Consequently, it is important to hire workers who match your needs. Because technology continually changes, MIS workers need education and training programs. Some companies are good at recognizing talented workers and keeping them happy. Several business publications annually list the best companies, and best IT companies to work for. Reading these lists and the description of benefits will give you some interesting ideas on how to attract and keep the best workers. Sometimes benefits are expensive, other times, simple recognition of employee contributions is enough to improve a workplace. These issues are covered in more detail in HRM courses.

Reality Bytes: The Changing Role of MIS

The role of the MIS department has changed over time. In many respects, it is in the middle of a fundamental change. In the past, MIS departments focused on creating information systems and controlling data—particularly transaction data. Today, as explained by the Gartner Group (an IS consulting firm), the objectives of MIS are:

- Provide transparent access to corporate data.
- Optimize access to data stored on multiple platforms for many groups of users.
- Maximize the end-user's ability to be self-sufficient in meeting individual information needs.

These changes represent a shift in attitude. It moves toward the goal of increasing support for workers, not their replacement, so employees can do their jobs better on their own.

Hiring workers with specific skills is always challenging because the desired skills change. Read a few job ads and you will see a jumble of acronyms. Some companies insist on trying to hire workers with specific experience and skills that fit into a narrow definition—or they list every possible current acronym they can think of. Other companies search for bright, motivated workers who can solve problems and learn new technologies. Regardless of your approach, it is difficult to determine the exact skills of any potential employee. IT **certifications** exist for a variety of skill sets. Potential employees obtain these certificates by taking exams—usually created and monitored by vendors. For example, Microsoft has several levels of exams ranging from Office tools to database administration and software development using Microsoft technologies. The networking giant, Cisco, has several levels of exams for certifying that people meet basic skills in designing networks and configuring Cisco routers and switches. Companies can also ask potential employees to take independent exams—similar to final exams in college classes such as programming in C++. The community of workers and employers continually debates the value of these certifications. If you only need to ensure that someone has a basic skill in a particular technology, the certifications and exams can help verify that the person meets minimum standards. But certifications are not replacements for experience. And keep in mind that all technologies change. You need workers who are willing and able to learn new technologies, and you need to provide an environment that provides the tools and training to keep everyone up to date.

IT workers can also be hired on a contract basis—to solve specific short-term problems. In some cases, these workers might be located in other countries and found via outsourcing Web sites. Managing contract workers is critical. You need to be able to communicate effectively and define precisely what tasks need to be accomplished.

Planning and Integration

One key issue in managing information technology is organizing the MIS function so that it matches the structure of the firm. Centralization versus decentralization has been a key issue in the organization of MIS resources. Networks and powerful personal computers have led to more options supporting decentralization of information. The increased options are useful, but they create more issues that managers must examine. Many arguments arise in organizations over how to

Reality Bytes: KLM Royal Dutch Airlines

Many large companies typically buy PC hardware and software for employees. More specifically, the IT department chooses a brand of computer, loads the software, and gives the PC to the employee to use. Companies that provide cell phones to employees use the same process—choose one common phone model and give it to everyone. Rarely does the employee have any options or choice. At KLM Royal Dutch Airlines, a subsidiary of Air France-KLM SA, employees were unhappy with this process. In November 2006, Martien van Deth, a senior technology officer in Amsterdam, tried a new approach with 50 IT staff employees. He gave each person a budget allowance of $203 to purchase a company cell phone for two years. Anyone wishing to buy a more expensive phone paid the difference in cost, anyone picking a cheaper phone could pocket the difference. The phones had to run Microsoft Windows Mobile version 5 or 6, and users had to deal with technical support themselves. If the phones broke, they had to replace it. Employees loved the new plan, and it was cheaper than the $231 the company typically paid for phones and support. Mr. van Deth decided to roll out the plan to other employees and expand it to cover laptops. Eli Lilly is considering going even further. Adrian Seccombe, chief security officer, suggested that his company might stop providing PCs to employees. Similar to the way the company reimburses employees for using their personal cars for travel, the company will reimburse employees for Internet costs. Other companies are reluctant to let employees make decisions about technology because of potential security issues and having a huge mixture of products is harder to service. On the other hand, many corporate applications are based on Web browsers, and employees can use them with devices ranging from desktops to cell phones. With browser technology, BP PLC was able to start an employee allowance program, giving them $1,000 a year to choose and maintain their own computers.

Adapted from Ben Worthen, "Office Tech's Next Step: Do It Yourself," *The Wall Street Journa*l, July 3, 2007.

integrate technology. Most organizations have an existing structure, and the IT support needs to match that structure. Forcing central IT decisions on a decentralized organization might appear to save money, but it can seriously impede worker productivity. When business workers waste time fighting with central decisions or not getting the data they need, the business can quickly burn off any potential savings.

The issue of new technology points out the importance of planning. The only way to control costs and evaluate MIS benefits is to establish a plan. Plans need to be detailed so actual results can be compared to the plan. Yet plans need to be flexible enough to adapt to unexpected events and new technology. You also need to formulate contingency plans for events that might occur.

Evaluation, Oversight, and Control

MIS is a service organization, which means that technology contributes through helping other workers do their jobs better. One way to evaluate an MIS organization is to ask business users to evaluate the level of support. Several survey instruments have been created to help assess user satisfaction with information systems. Presumably, if the IT department is doing a good job supporting the users, they

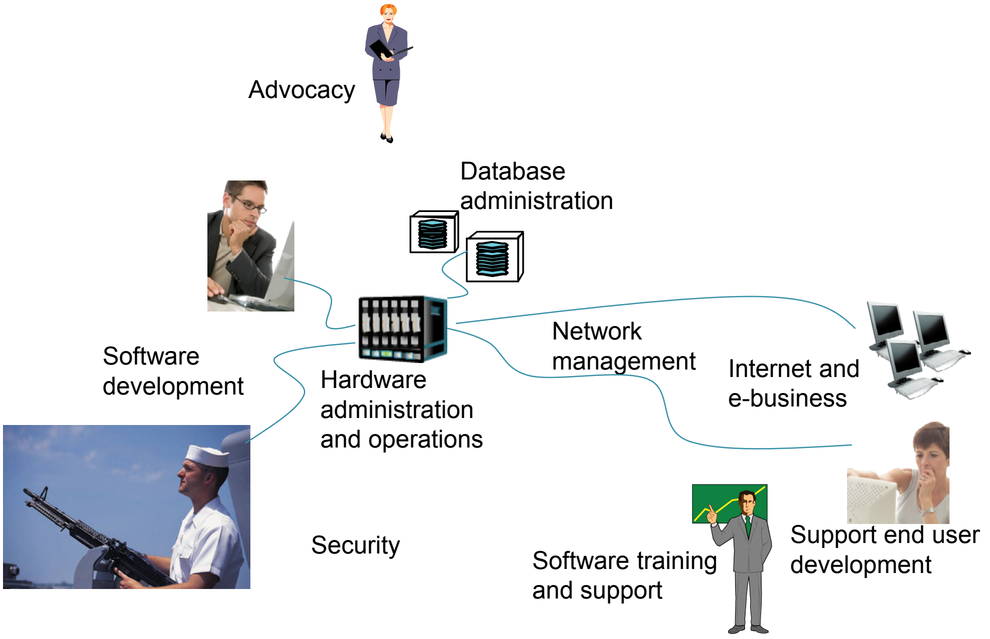

Figure 13.2

MIS roles. The MIS department is responsible for hardware administration, software development, and training and support. MIS staff manage networks, provide computer security, develop Internet and e-business applications, and establish corporate computing standards The MIS department also plays an advocacy role, presenting the IT benefits and strategies to the executive office.

will be happy with the support. Of course, it is also possible that users will never be happy.

Part of the problem comes down to economics. If workers look on IT as a magic genie, they will never be happy until they have the latest toys. But, someone has to pay for all of the technology. Is Joe in accounting complaining about MIS because he needs better data or because he wants a new Web-based cell phone? Economics explains that when users do not pay for items, they are unlikely to choose a cost-efficient solution. This problem was more acute when technology was expensive. Many companies instituted **chargeback** schemes to solve the problem. Chargeback or transfer pricing means that the MIS department bills for its services—in terms of hardware, software, and personnel. Many different chargeback methods were developed; including fixed monthly fees, project-based fees, and fees for individual services, such as printing or consulting. Several large organizations still use chargeback methods—particularly for large infrastructure items such as network support. The basic goal of transfer pricing is to obtain economically efficient solutions by billing departments for their usage of technology. In a perfect scheme, departments will use the prices to buy exactly as much IT services as they need to improve their profitability. A side benefit to chargeback methods is that user departments potentially gain some control over IT. Because they are paying for service, they can choose to stop buying IT services or go elsewhere if the costs are too high or the service quality is low.

The catch to any transfer price is that it is extremely difficult to find the true price for the services. When the same service can be purchased externally, a market economy can drive the price to efficient levels and it can be used as a comparison. Historically, internal chargeback prices tended to be relatively high—with no incentive for the MIS department to behave efficiently. With the increasing availability of outsourcing, it is now possible to obtain more accurate prices for many types of services. But many organizations fail to search for and use these numbers, so reports of excessive overcharging still exist.

Ultimately, someone needs to help the IT organization understand the business needs of the users. In smaller companies, these discussions can be handled at the executive level. In larger companies, it is more efficient to establish an oversight group that is run by the business departments. The oversight group can coordinate plans, share information, and discuss conflicts and costs.

MIS Roles

What roles and tasks does the MIS department perform? Good information systems do not simply materialize from thin air. Providing timely, accurate, and relevant information requires careful planning and support. Creating effective information involves maintaining hardware, providing software training and support, supporting end-user development, defining and controlling access to databases, establishing corporate standards, and researching the competitive advantages of new technologies. These basic roles of MIS are outlined in Figure 13.2.

Hardware Administration

In some respects, hardware administration has become a little easier in the last few years. Computers are more reliable, more standardized, and cheaper. It used to be difficult to accommodate users who needed slightly different hardware. Many companies still prefer to standardize PC hardware to simplify purchasing and asset tracking. But with common three-year support contracts, standardized hardware, and low prices, it is less and less important to require that all employees have the exact same computer. Instead, most companies need to choose a time frame for updating their computers. For most purposes, three years has been shown to be a productive length of time to hold a PC. On the other hand, some companies require groups of employees to have exactly the same hardware. MIS can then make a standard copy of the configuration and software and reload this image if anything goes wrong with a user's computer.

Mobility has become an increasingly important issue for many business computer users. More managers are requesting the use of laptops instead of (or along with) desktops. Mobile systems including Internet-accessible cell phones change the picture even more. Fortunately, the cost of most of these devices has dropped as well. Consequently, purchasing is less of an issue. Instead, mobile systems present more problems in terms of security—beginning with loss of the equipment.

Purchase costs do not represent the entire cost of hardware. In the mid-1990s, a few companies began pushing a concept they called **total cost of ownership (TCO)**. The basic issue is that someone has to configure the PC, install software, and troubleshoot problems. At the time, most of these tasks required an on-site MIS support person, which was expensive. Various attempts were made to estimate these additional support costs and derive the TCO. The slightly hidden objective was to show that centralized computers were not really more expensive

Reality Bytes: The Changing Role of MIS

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than personal computers. While most of the numbers from this process were unreliable, the process did highlight the difficulties of maintaining personal computers. Consequently, several firms created tools to install software and troubleshoot PCs from a central location over the LAN.

The move toward Internet-based applications removes many of the issues of managing personal computer hardware. As long as the systems support the Internet standards, and as long as they can be purchased inexpensively, there is little need for detailed MIS oversight. On the other hand, the central servers that run the Web sites, databases, and applications become more important. MIS personnel need to monitor the performance of the servers, provide backup plans, maintain security, and plan for capacity increases.

Capacity planning is a major factor in MIS organizations. Building scalable systems is an important goal for most organizations. The objective is to purchase only the level of hardware that is needed. Then, as demand increases, add more servers or larger servers to handle the increased load. This process holds down central hardware costs, but it means that MIS has to carefully design the systems and carefully monitor the usage and predict future demands.

Software Support

Software generally requires more support than hardware does. MIS staff can help users decide which software to purchase and then install it. Users need to be trained to use various software features. Whenever workers change jobs or a company hires new workers, they need to be trained. Similarly, commercial software versions change almost every year, requiring more training for users. In addition, someone has to install the new copies on the machines, distribute manuals, and convert data files.

When users have difficulty getting the computer to do what they want, it saves time to have someone to call for help. Most MIS departments offer training and some level of user support—particularly for complex systems such as the ERP or accounting systems. However, as funding for IT get cut to reduce costs, companies increasingly expect users to answer their own questions. Technical support often gets reduced to solving basic hardware problems. In most cases, it is easiest to find a co-worker with the answer.

Network Support

Both wired and wireless networks are critical to running a company. Managers rely on the networks being available 24 hours a day, 7 days a week. Fortunately, most modern network equipment is reliable and can run continuously for months. Moreover, network managers can build networks that can correct for failures and bottlenecks by routing traffic around a switch that has failed.

Network support becomes more complicated when managing Internet connections. Connecting to the Internet requires some specialized skills to configure the router. Once the connection is established, configuring the router for security becomes critical. Monitoring the connection and keeping up with current security advisories are even more challenging. Larger companies train specialized personnel to handle these tasks. Smaller companies often rely on consultants or contractors.

Wireless networks are relatively easy to install—although corporate hardware is often more complex and more powerful than the wireless router you install in your home. And they are much more difficult to configure if you are concerned about security. Several true stories exist of people sitting in parking lots or even passing commuter trains and establishing a wireless connection into a company's network. Network specialists are trained to configure networks to minimize these problems.

Software Development

Developing software and business applications is difficult. Projects can require teams of hundreds of developers. Even smaller projects and purchases of larger software applications require devoted attention to detail. Managing software development and purchases is a critical role in MIS. Beginning with project evaluation and feasibility studies, through project management and tracking progress, to evaluating the team efforts, someone has to be in charge of the details.

These tasks are some of the more traditional roles in MIS. They are also the most difficult. Unfortunately, most companies have poor track records in managing software projects. Many development projects fail, and even more are behind schedule and over budget. Consequently, many firms choose to buy software or use outside companies to help in development projects. Even in these cases, someone in MIS has to be responsible for evaluating choices and monitoring progress.

Support for End-User Development

Many application packages include programming capabilities. For example, a manager may create a spreadsheet to calculate sales commissions. Each week, new sales data is entered and the spreadsheet automatically produces summary reports. It would be better to have a clerk rather than a manager enter this new data. To make the clerk's job easier, the manager uses the macro capabilities in the spreadsheet to create a set of menus and help messages. Similarly, using a word processor's macro facilities, a legal department can create standard paragraphs for various contracts. With them, an assistant can type one word to display a prewritten warranty paragraph. In theory, even complex applications traditionally provided by the MIS department, such as accounting systems, could be programmed by end users with prepackaged software.

Several problems can arise from these end-user applications. Techniques that are acceptable for small projects may lead to errors and delays with large systems. Programming major applications requires obtaining information from users and

Reality Bytes: Google as a Software Developer

Most people in the world use Google software. But few people think about how that software gets developed, or the number of people it takes to create and improve the tools you use on a daily basis. In 2011 alone, Google planned to hire more people than the 6,000 it hired in 2007, its previous record year. By the end of 2011, the company expects to have over 24,000 employees. Not all of the employees are developers—increasingly, the firm hires salespeople to work with online and local companies. But Google continually works to develop new tools and new concepts—including software for self-driving cars. One aspect to software development at Google is that the company emphasizes small teams of software engineers—with an average of 3.5 developers on a team. The objective is to encourage communication and get developers to treat projects as start-ups.

Adapted from Amir Efrati, "Google Steps Up Hiring," *The Wall Street Journal*, January 25, 2011.

managers. Applications designed for corporate use require extensive checking of data and security provisions to ensure accuracy. The software often needs to run on different operating systems and local networks.

The MIS department can provide assistance to minimize these problems. MIS personnel can assist end users in collecting ideas from other users. They can also help in testing the applications to verify the accuracy and make sure the software works with other applications. MIS can provide tools and help end users document their applications and move them to new operating systems or new hardware. Programmers can write special routines to overcome any limitations of commercial software that might arise. MIS staffs also maintain help desks or information centers to answer user questions and help users debug applications.

Corporate Computing Standards

Over time, MIS has learned that the firm gets into trouble if all of its people work independently. In the 1960s, applications such as payroll, accounting, and customer order processing were developed independently. During the 1970s, companies had to spend large amounts of money getting all of the pieces to work together. In the 1980s, personal computers arrived, and the problems got worse.

Reacting to the problems created by these incompatibilities, MIS professionals at different companies developed **standards**. If all vendors used standard formats for files, hardware connections, and commands, products from different vendors could be used together. Today, there are standards for everything: data, hardware, software, report layouts, and coffee pots.

It is unlikely that the computing world will ever see complete cooperation among vendors. Three factors prevent products from working together. First, standards are often ambiguous or incomplete. Human languages always have some ambiguity, and there is no way to determine whether the description actually covers every possible situation. A second problem is that standards incorporate what is known about a topic at the time the standard is developed. Computing technologies change rapidly. Often, vendors can produce better products by not following the standards. Then new standards have to be developed. A third problem occurs because vendors want to distinguish their products from the offerings of competitors. If there were standards that perfectly described a product, there would be only one way to compete: price. Many vendors find that it is more profitable to offer features beyond what is specified in the standards, enabling the developers to charge a higher price.

Even though it is not possible to create perfect industry standards, there are advantages to creating companywide standards. They enable firms to buy products at lower prices. Most large businesses have special purchase agreements with hardware and software vendors. Buying in bulk allows them to obtain better prices. Similarly, it is easier to fix hardware if all the machines are the same. Likewise, it is much more convenient to upgrade just one word processing package for 200 computers, instead of 20 different brands. Similarly, training is less expensive and time consuming if everyone uses the same software and hardware. Finally, standards make it easier for employees to share information across the company. The Internet and e-mail create additional demand for standards. To share a file on the Internet, you must store it in a standard format (e.g., HTML or PDF). People sometimes forget that a similar problem arises when attaching files to e-mail messages. Particularly when you send a file to someone in a different company, you need to remember that the recipient may not have the same version of software that you are using. Because Microsoft has over 90 percent of the market for basic office software, file sharing had not been an issue for years. However, Microsoft changed all of the file formats with the release of Office 2007. File converters enable users to share files from the newer and older versions, but the conversions are not perfect and some formatting and layout is usually lost. Since some companies upgrade before others, it is generally safer to save attached files in either a standard format (HTML or PDF) or a previous version.

Some organizations forget that standards cannot be permanent. Hardware and software change almost continuously; new products arrive that are substantially better than existing standard items. Similarly, as the business changes, the standards often have to be revised. Also, there are exceptions to just about any policy. If one department cannot do its job with the standard equipment, MIS must make an exception and then figure out how to support this new equipment and software.

Data and Database Administration

Databases are crucial to the operation of any company. Keeping the databases up-to-date and accurate does not happen by chance. Larger organizations employ a **database administrator** (DBA) to be responsible for maintaining the corporate databases, monitoring performance of the database management system, and solving day-to-day problems that arise with the databases.

Companies also need someone to coordinate the definition of the data. Large organizations might hire a separate **data administrator** (DA); smaller companies will pass this role to the DBA. The DA is responsible for defining the structure of the databases. The DA has to make certain the data is stored in a form that can be used by all the applications and users. He or she is responsible for avoiding duplicate terms (e.g., customer instead of client). Furthermore, the DA provides for **data integrity**, which means that the data must contain as few errors as possible.

The DA is also required to maintain security controls on the database. The DA has to determine who has access to each part of the data and specify what changes users are allowed to make. Along the same lines, companies and employees are required by law to meet certain privacy requirements. For instance, banks are not allowed to release data about customers except in certain cases. European nations

Reality Bytes: Business Trends: Specialization

Just as in other areas of business, MIS jobs have become highly specialized. For instance, many advertisements for MIS jobs look like someone spilled a bowl of alphabet soup on the page. Companies often search for technical skills involving specific hardware and software.

Unfortunately, this approach to jobs causes problems for MIS personnel. In order to find other jobs or to advance in their current position, they have to acquire increasingly detailed knowledge of specific hardware and software packages. Yet with rapid changes in the industry, this knowledge can become obsolete in a year or two. These changes mean employees have to continually expand their knowledge and identify software and hardware approaches that are likely to succeed.

On the other hand, businesses need to keep their current applications running. With thousands of hours invested in current systems, companies cannot afford to discard their current practices and adopt every new hardware and software system that shows some promise.

have much stricter privacy rules. If a firm operates a computer facility in many European countries, the company must carefully control access to all customer data. Some nations prohibit the transfer of customer data out of the country. The DA is responsible for understanding these laws and making sure the company complies with them.

Finally, because today's databases are so crucial to the company, the business needs a carefully defined disaster and recovery policy. Typically that means the databases have to be backed up every day. Sometimes, a company might keep continuous backup copies of critical data on separate disk drives at all times. MIS has to plan for things that might go wrong (fires, viruses, floods, hackers, etc.). If something does affect the data or the computer system, MIS is responsible for restoring operations. For instance, an alternate computing site might be needed while the original facilities are being repaired. All of this planning requires considerable time.

Security

Since most of today's business data is stored in computers, computer security has become a critical role for the MIS department. Often this role is shared with the accounting department to establish standards and procedures to ensure the integrity of financial data. Medium and large organizations have full-time computer security officers to set policies, establish controls, and monitor systems for attacks. Because of the constant evolution of new threats and the large number of systems and employees, the task can be immense. Attackers often search for one little hole in one system or one mistake by an employee. Security managers have to keep up with hundreds of different systems and applications to make sure that all of the holes are plugged. But, because security systems are never perfect, security administrators must also run monitoring tools to watch for and stop ongoing attacks.

Security administration also includes training users, testing system configurations, and monitoring networks for ongoing attacks. Establishing incident response plans and teams is also a major task. When things go wrong, you need a team and a plan to identify the problem, stop the attack, and restore business functions as quickly as possible. Along the way, you have to collect and maintain evidence that can be used in court cases, so that if you catch the attackers, you can file charges against them.

Advocacy Role

The MIS department is headed by a single manager, who often is called the chief information officer (CIO). The CIO position might be a vice president or one level below that. A major portion of this job involves searching for ways in which the information system can help the company. In particular, the CIO searches for and advocates strategic uses of MIS. The goal is to use the computer in some way that attracts customers to provide an advantage over the company's competitors.

The MIS goal is to help the organization and the other managers. But most business managers are not experts in technology. Whenever a new technology is introduced, someone has to be responsible for deciding whether it will be worth the expense to make a change. If there is no one in this **advocacy role** who evaluates the existing systems and compares them to new products, an organization is probably not often going to get new equipment. Even when many users are dissatisfied with an existing system, they will have a better chance of acquiring new technology if they can voice their complaints through one highly placed person. Along these lines, the CIO is responsible for long-run planning in terms of information technology.

MIS Jobs

What MIS jobs are available, and how much will it cost to hire IT employees? A wide variety of jobs are available in MIS. Some of the jobs require a technical education, such as that for programmers. Specialized positions are available in data communications and database management. On the other hand, **systems analysts** require an extensive knowledge of business problems and solutions. Some entry-level operator jobs require only minimal training. On the other end of the scale, analysts may eventually become team leaders or managers. The entire MIS function is coordinated by chief information officers.

As you might expect, salaries depend on experience, individual qualifications, industry, location, and current economic conditions. Seven basic MIS job tracks are shown in Figure 13.3: systems development, networks, database, security, user support, operations, and other specialists. Systems development includes several levels of analysts and programmers. Network management involves installing network hardware and software, diagnosing problems, and designing new networks. Database management focuses on database design and administration. End-user support consists of training users, answering questions, and installing software. Security tasks include configuring systems, working with programmers, and monitoring ongoing operations. Operations consist of day-to-day tasks such as loading paper, mounting tapes, and starting long computer tasks. Many of these tasks are being automated. Entry-level operator jobs do not require a college degree, but there is little room for advancement without a degree. Specialist positions exist in larger companies and generally evolve from new technologies. For example, Web masters who would create and manage Web sites were in high demand for two or three years; then as the Internet became more important to companies, Web workers became even more specialized including design, e-commerce, and EDI specialists.

Every year, *Computerworld* surveys workers in the industry and publishes average salaries. Job placement firms such as Robert Half also collect data on

Systems Development		IS Management	
Director	$175,000	CIO/VP IS/CTO	$191,000
Project manager	102,300		
System analyst	79,200		
Senior Developer	92,300		
Programmer/analyst	77,000		
Junior programmer	56,800		
Internet		**Networks**	
Director/strategy	$156,400	Manager	$90,500
Manager	88,500	Administrator	64,100
Application develop.	66,000	Network engineer	77,300
EC specialist	72,700	Junior analyst	44,000
EDI specialist	68,000		
Database		**Security**	
Manager	$10,800	Chief security	$162,000
Architect	117,000	Manager	99,000
DBA	89,300	Specialist	89,000
Analyst	75,800	IS audit manager.	109,000
		IS audit staff	70,400
Operations		**User Support**	
Director	$104,600	Manager	$75,300
Manager	80,000	Technical trainer	64,600
Systems admin.	70,300	Help desk operator	56,200
Lead operator	53,800	PC technical support	51,600
Computer operator	37,400		

Figure 13.3

IS salaries. As in any field, salaries depend on experience. However, in IS they also depend heavily on technical skills. Programmer/analysts with current skills and experience in new technologies find it easier to get jobs and obtain higher salaries. Note that there is a wide variety of jobs in IS, each requiring different types of skills.

salaries. The *Wall Street Journal* and several other companies have Web sites that provide salary information for various jobs and locations. This data can be useful if you are searching for a job or thinking about a career in MIS. As a business manager, the numbers will give you an indication of the costs entailed in building and maintaining information systems. Basic averages are listed in Figure 13.3.

One way to see the changes occurring in MIS is to look at the types of skills that businesses are looking for in MIS applicants. Figure 13.4 shows some of the top skills demanded in 1994, 1998, 2001, and 2004. Notice the demand for COBOL to fix date problems with old software. Then demand shifted to new technologies (ERP and groupware). In 2004, demand for applications development and management increased, along with a renewed interest in security.

Figure 13.5 shows another perspective on the costs of programmers by comparing costs across nations. With the worldwide expansion of the Web, it is possible to hire programmers from almost any area of the world. Economically, the U.S. has long had a relative shortage of labor. Programming requires considerable education and experience, but nations such as India and China have huge populations and the ability to educate and train programmers. Russia and other Eastern Euro-

Year/ Rank	1	2	3	4	5
2010	Java/J2EE	Security	Software Developer	SAP	Database Management
2007	Business Analyst	Windows Administrator	Program Manager	Offshore Project Manager	Vendor Manager
2004	Application Development	Project Management	Database Management	Networking	Security
2001	ERP	Object Engineering	Data Warehouse and Visualization	Groupware	Wireless
1998	ERP	Groupware	Database	Networking	COBOL

Cooney, February 25, 2011, "IT Graduates not 'Well-Trained, Ready-to-Go'," *Networkworld*.
Ware, January 2004 IT Staffing Update, CIO Magazine, February 3, 2004; *Computerworld*, "In Demand: IT starts require premium pay," December 10, 2001; *Computerworld*, November 16, 1998; and Arnett and Litecky, *Journal of Systems Management*, February 1994, www.cio.com/article/101314, 2007.

Figure 13.4

MIS skills in demand. At any given time, some skills are in demand—reflecting demand for applications and a shortage of workers for new technologies. Other skills are also in demand, but workers with the listed skills generally received premium wages and bonuses.

pean nations have had historically high unemployment rates, and educational systems that at least in the past focused on mathematics and science. Consequently, at various points in time, salaries for workers in these countries have been lower those in Western countries.

Of course, employees in countries such as India also have lower costs of living, so the salary is relatively high. In terms of hiring programmers from one nation instead of another, it is also important to look at productivity rates. Although it is difficult to measure, programmers in the U.S. have some of the highest productivity rates in the world. Economic theory shows that ultimately wages relative to productivity will equalize across nations. Some of this effect can be seen in the increasing wages for programmers in India.

Outsourcing

Do you really need to run all of the MIS operations yourself? In the past 20 years, many businesses have noted that it has become difficult to terminate or lay off employees. In MIS, it has also been expensive for firms to hire the best people. Consequently, many firms have chosen to outsource various aspects of their MIS functions. The basic premise is that specialized firms can offer more efficient service at better prices. For example, EDS runs huge data centers, and it is relatively easy to add more clients with only minor increases in costs. As a huge MIS organization, EDS also hires and trains thousands of work-

Nation	Programmer/Analyst Salary
United States	52,100-900,000
Britain	45,000-80,000
Russia	19,000-34,000
China	14,000-25,000
India/Bangalore	9,000-18,000
	6,000-12,000-30,000

Data in U.S. dollars. Differences can be affected by other factors, including benefits, cost of living, productivity, access to equipment, and transportation and communication costs. See www.payscale.com and www.salarymap.com.

Figure 13.5

Internationalization. In the past few years, U.S. and European firms have turned to using programmers in other nations. For example, U.S. programmers are paid about 5-10 times as much as Indian and Russian programmers. Both India and Russia have extensive educational programs. India and China have a large number of people.

ers. Outsourcing also is attractive to firms as a temporary measure. For example, firms might outsource their old accounting systems while designing and installing a new ERP system. The old system will continue to function and be ably supported by an expert company. The internal employees can focus on designing and installing the new system.

Outsourcing can take many forms. Firms might sell their entire computer center to an outsource specialist—and all of the data, software, and employees would move to the new company. Other firms might contract out other MIS functions such as network management, PC repair, training, security, or development. Some functions, particularly programming, can even be outsourced to companies based in other countries. India has several companies, led by Tata, that specialize in writing programs for American and European firms. Using these firms in other countries to handle MIS (and other tasks) is known as **offshoring**.

Two of the leading service providers are Electronic Data Systems (now owned by Hewlett-Packard) and Global Services, the IBM subsidiary. Some other leading outsourcing companies are listed in Figure 13.6. Note the continuing growth in outsourcing. Initially, this trend was partly due to the desire to cut costs, the inability to hire IT workers, the increasing standardization of IT services, and the need to focus on core business management. In 1998, *Computerworld* reported that an average of 20 percent of IS budgets was spent on outsourcing. Generally, a company signs an agreement to use the services of the outsourcing firm for a fixed number of years. Depending on the agreement, the outsourcing firm can be responsible for anything from machine operation and maintenance, to development of new systems, to telecommunication services.

Figure 13.7 shows the total value of the revenue for the main outsourcing and consulting firms. Even without the revenue from the smaller firms, the trend is clear. Business organizations are increasingly relying on these outside specialists to develop software and handle other MIS tasks. Throw in software-as-a-service where companies can lease Web-based software, and it is clear that business orga-

Company	1991	1995	1997	2000	2003	2006	2010
IBM Global Services	0.4	17.7	24.6	37.0	42.6	48.2	56.4
EDS	1.2	12.4	15.2	19.2	19.8	21.3	40.8
Accenture	0.5	4.2	6.3	9.8	11.8	18.2	23.1
CSC	0.4	4.2	6.6	10.5	11.1	14.6	16.1
ADP	0.3	3.0	4.9	7.0	7.1	6.9	8.9
Affiliated Computer	0.2	0.4	1.2	2.1	3.8	5.3	9.5
Fiserv	0.2	0.7	1.0	1.7	2.7	4.5	4.1
Perot Systems	0.2	0.3	0.8	1.1	1.5	2.3	3.5
Tata/TCS					1.4	4.2	6.8
Wipro		0.3			1.3	2.4	6.1
InfoSys					1.0	3.2	4.8
Cognizant				0.1	0.4	1.4	4.6
Satyam				0.2	0.5	1.1	1.2
HCL Tech			0.1	0.2	0.4	1.0	2.7
total ($ billion)	3.4	43.2	60.7	88.9	105.4	134.6	188.5

Figure 13.6

Outsourcing revenue. In the latter half of the 1990s, outsourcing with the major providers accelerated as many companies chose to hire outside firms to run various MIS functions. For 2000 and beyond, much of the outsourcing is for ERP systems and Web hosting. Data is taken from annual reports and company Web sites.

nizations are interested in having someone else deal with the hassles of running an MIS department. It is no wonder that two of the top-five MIS skills in 2007 were the ability to deal with vendors and project management of offshore providers.

Outsourcing has primarily been used to decrease operating costs or to get the initial money from the sale of the machines. In particular, the company gains an infusion of cash through the sale of the machines. Some firms have stated that they chose outsourcing because it enabled them to focus on their core business and not worry about maintaining computers and designing systems. Today, outsourcing Web site hosting and development is relatively common. Few firms have the expertise to securely configure the networks and servers required for e-businesses; so they pay outside firms to handle the technical details.

Figure 13.8 lists conditions under which it is useful to consider outsourcing. Remember that you can choose which technologies you wish to outsource and which to keep in house. Each company has a different collection of applications, hardware, and workers. A key economic point with outsourcing is that you convert upfront fixed costs into somewhat variable monthly fees. Instead of purchasing expensive hardware and software, you pay a monthly fee to have someone else handle the details. It is also a convenient method for companies to obtain IT management. Many companies do not know how to run an IT department, Web site, or ERP system. A major benefit to outsourcing is the opportunity to hire experts in IT management.

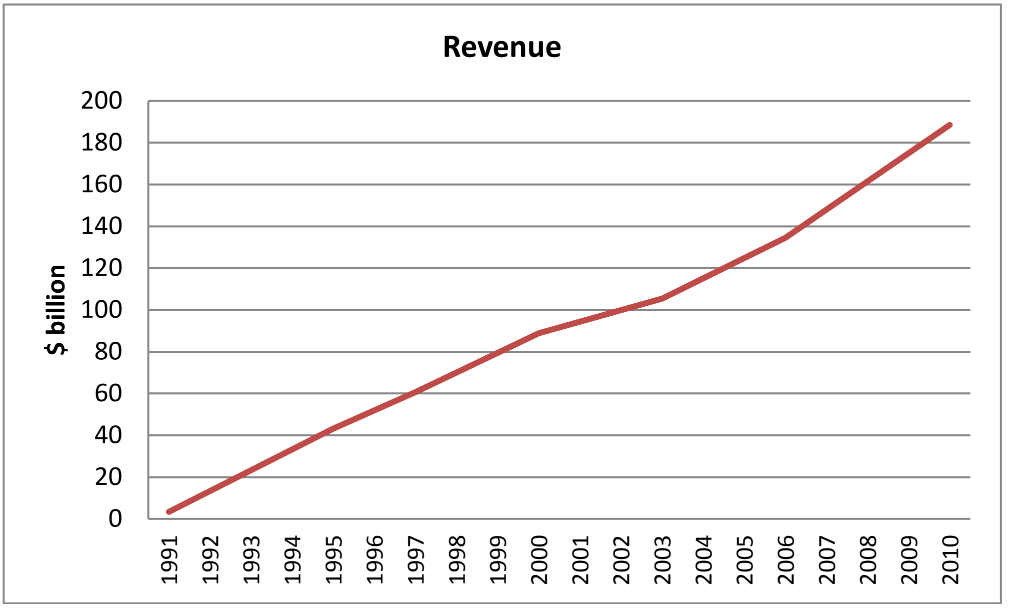


Figure 13.7

Outsourcing trend. The growth of the consulting/outsourcing firms has been constantly high for over 15 years. Organizations are increasingly turning to these specialists to develop software and run MIS operations.

On the other hand, situations that are unique or require advanced uses of information technology are best handled internally. For example, complex markets that benefit from strategic applications require the knowledge and experience of employees who work for the company. Likewise, situations that require tight security are easier to control if they remain in-house. Also avoid outsourcing when the outsourcing firm will have to pay the same costs that you face—because they will charge for an additional profit margin, the final cost can be higher. Examples include applications with high fixed costs or those requiring high levels of expensive state-of-the-art equipment or specialized MIS talent.

Competitive pressures are also leading many managers to consider outsourcing their information systems. As technology continues to change, it becomes increasingly difficult for general business managers to keep up with the technology. Each change brings requests for new hardware and software, and the need to reevaluate the use of technology within the firm. Changing technology also requires continual retraining of the information systems staff. At the same time, middle-level management positions are being cut, and managers are asked to take on more tasks. In these circumstances, companies decide to transfer IS management to an expert through outsourcing.

Outsourcing has many drawbacks, and several studies have reported that the majority of companies that sign long-term contracts cancel those contracts within a few years. As reported in *CIO Magazine*, a study by DiamondCluster in late 2002 revealed that 78 percent of IT executives had to terminate outsourcing contracts early.

Condition	**Outsource**	**In-House**
Specialized talent High fixed costs Level of technology	Standard workers, hardware, and software are readily available at fixed fees.	If you need expensive workers or technology, you can save the mark-up profits and keep control over selection.
Security and control	Providers can afford specialists and provide solid basic security.	Data that requires absolute secrecy needs to be kept in-house.
Strategic use of IT	Providers can handle standard technology.	Unique applications and new ideas come from in-house.
Company size/resources	Small companies get access to specialists and shared resources. You can purchase the level of technology you need and expand as you grow.	Large companies can afford IT staff and specialists, but might choose to convert fixed costs to monthly costs.

Figure 13.8

Outsourcing evaluation. Outsourcing entails many trade-offs. It means transferring control of a crucial resource to an outside company. If you are really interested in development of strategic applications and leading-edge applications, it is usually better to use an internal development team. If you are dealing with older technology used mostly for transaction processing, it can be cheaper to hire an outside firm to maintain your applications.

First, there might be a slight increase in security risk because the MIS employees have weaker ties to the original company. On the other hand, outsourcing providers are likely to have stricter security provisions than an average firm does. A bigger question is the issue of who is responsible for identifying solutions and new uses of technology for the firm. If MIS workers are employed by an external firm, will it be their job to search for new applications? If not, who will?

In the past few years, some firms have begun to reconsider the costs of outsourcing. The hosting firm has little incentive to strive to reduce its prices or improve its services. Moreover, it can be difficult to control the decisions of the outsourcing firm. Consequently, some firms have become more selective over which items are outsourced. Before you consider outsourcing, make sure you understand the answer to three critical questions: (1) How will you ensure adequate service? (2) How will you control costs? (3) Will it provide the flexibility you need if your strategies change? Most contracts establish base costs, but additional requests are charged at higher rates. The industry essentially created the concept of a **service level agreement (SLA).** An SLA is a defined performance measure that is specified in the contract. For example, a contract might specify that an outsource vendor must provide a new network port within 24 hours of the initial request. These agreements generally contain penalty clauses in the form of reduced payments. Some internal MIS organizations have mimicked the approach by writing SLAs for basic services. The main benefit to an SLA is that it provides a defined measure of the organization's capabilities. The drawbacks are that (1) it is difficult to specify all of the detailed SLAs that you might need, and (2) contracts rarely encourage continuous process improvement.

Reality Bytes: New Clorox CIO Fixes Problems with Outsourcing

Clorox is a $5.5 billion company headquartered in Oakland, CA with 8,300 employees. The company might be a familiar name to people because of its bleach, but the company owns more than 30 other brands including Kingsford charcoal, glad bags, and Bert's Bees. For several years, the company had outsourced much of its IT function, largely to HP. IT was largely run as a cost center and the company was not seeing the productivity and efficiency gains they had expected. In April 2010, the company hired Ralph Loura as a new CIO, who noted that the company was under-invested in people and technology. When he arrived, it was still running Windows 2000 on desktops , and out of date ERP and CRM system, and a version of Lotus Notes for e-mail that was several versions out of date. Internationally, the company had 15 different ERP systems in 18 countries. In an interview, Loura commented that "There had been this kind of, 'If it isn't broke, don't fix it' view, which is contract behavior right? You do the least amount necessary to maintain the SLA with no idea that certain upgrades create value by unlocking productivity through the features in the solution." Solving the problems required going through the company to talk to users about problems and things that worked, then prioritizing tasks and assigning them to categories. To change attitudes, Loura redefined the role of the business systems manager to make it a client manager, responsible for identifying and meeting the needs of the client, instead of focusing on the technology system.

Adapted from John Dix, "New CIO Cleans Up Outsourced IT at Clorox," *Network World*, January 24, 2011.

Sometimes outsourcing contracts can backfire on the vendor. EDS won a contract with the U.S. Navy to supply computers and networks. According to *The Wall Street Journal* (April 6, 2004), EDS lost $1.6 billion on the contract and expected to lose about another half billion before it was completed.

Consultants and contract programmers are a simpler version of outsourcing. If you have a one-time task that requires workers you do not have on staff, you can simply hire them for the one job. The cost per hour might seem high, but you only pay for the specific job and you do not have to worry about firing anyone when the job is finished. One of the biggest issues with contractors is to ensure that your organization will be able to use and maintain the tools after the contractor leaves. You might need to arrange for access to the source code or for training sessions.

Managing contractors and outsourced operations are difficult tasks. It is not like buying a piece of software or hardware. You cannot simply assume that paying a fee will get you exactly what you want. Communication is critical. First, you must precisely define exactly what you want. Particularly when dealing with workers from a different country, it is likely that they have different interpretations of basic concepts. Second, you must build in progress monitoring and feedback to verify that everyone has the same interpretation of the concepts. Third, do not expect creativity, or even insight into your business operations.

MIS Organization: Centralization and Decentralization

Who should control IT resources? Two broad trends are slowly creating significant changes in the way people perceive and organize information: (1) de-

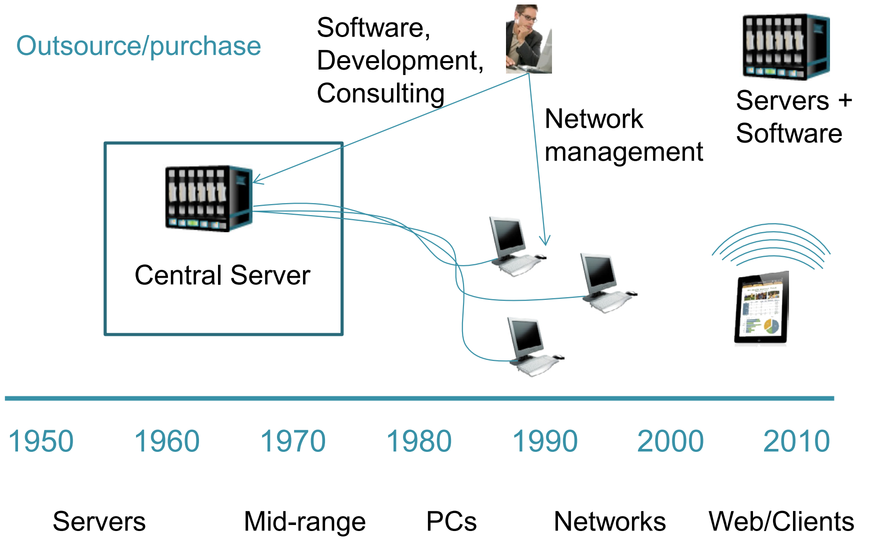


Figure 13.9

MIS organization timeline. Management issues are easier to see in the context of trends. Computing resources were initially large and expensive, so they were run from a completely central service. As hardware costs declined, mid-range and micro-computers spread through the organization causing some decentralization. Software development shifted to contractors and purchased software. Other tasks were outsourced. Around 2010, it became possible to re-centralize software and data on external cloud-based servers.

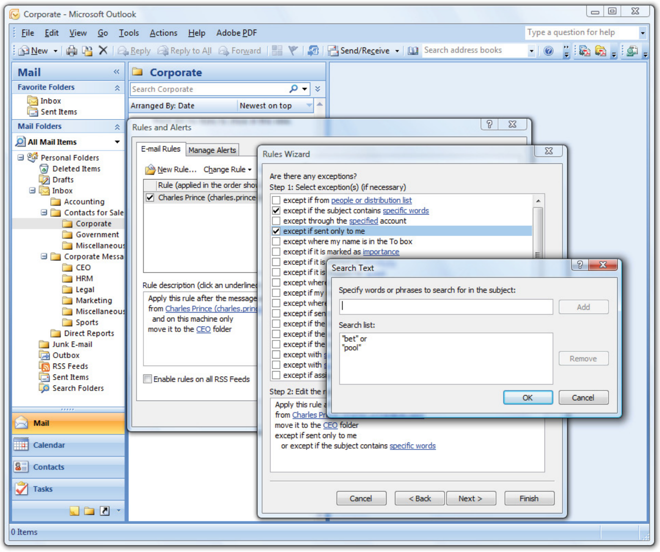
clining sizes and prices of technology, and (2) expanding access to the Internet—particularly wireless connections. Internet sites are slowly becoming repositories of information that is accessible any time from almost any location. External data on the economy, news, financial markets, consumers, competitors, and more is readily available on the Internet. Increasingly, you will have to pay for this data; but it is accessible. Advanced companies today are providing similar services in terms of internal organizational data. Data warehouses collect, clean, and present data to internal Web browsers. Ultimately, these databases will be integrated, so managers in a meeting can easily call up current sales data and combine it with economic forecasts on their handheld computers. The goal is to make integrated data available anywhere to authorized users. The question is, How should the MIS system be organized to provide these features?

As shown in Figure 13.9, it is helpful to examine IT management by looking at major trends. When hardware was expensive, all data, software, and employees were centralized. As the use of midrange and personal computers expanded, hardware became decentralized and software and data began to follow it. For example, decision makers stored spreadsheets, analyses, and reports on their personal computers. But this decentralized data is more difficult to share, even with networks. At this stage the Internet technologies become important—the search engines and browsers were designed to make it easier to find and view data in many forms. Applying these technologies within the company (called an *intranet*) provided easier access to corporate data. Network technologies expanded to provide faster

Technology Toolbox: Defining E-Mail Rules

Problem: You get dozens or hundreds of messages a day.

Tools: Microsoft Outlook and other e-mail client packages have rules and features to help you deal with the flood of e-mail.



Even if you remove the junk e-mail, many business managers receive dozens of messages a day. Groupware tools and automated project management systems add to the list. Some are important; others are minor but still worth saving. But even if you save the messages, you need a way to organize and search them so that you can respond to the most important ones first and then search the others later.

The first step in organizing e-mail is to create additional folders. Right-click the inbox folder to add new folders. The challenge is to make it easy to find the messages you receive. You can manually move messages into the relevant folders. However, Outlook enables you to create powerful rules to automatically evaluate and handle your messages. It effectively allows you to build an expert system agent that deals with many of your messages automatically. The simplest type of rule is one that automatically moves messages from a specified sender into a designated folder. For example, messages from the CEO could be moved into a critical folder. As you receive new messages, you can deal with the most important folders first.

You can create sophisticated rules. The Tools/Rules and Alerts option has a wizard to help you. Rules have three components: (1) conditions that are evaluated for each message, (2) an action to take, and (3) exception conditions to exclude certain messages. You have a couple dozen types of conditions or exceptions, such as choosing people or matching words in the subject or body. You can select from a couple dozen actions, including moving the message to a folder, deleting it, forwarding it, or even running a custom script or opening an application on your desktop. This last option might be used to open a sales application and generate a new order when a specific message is received from a customer. Since you can control the order in which rules are applied to each message, you can create a decision tree of multiple rules.

Quick Quiz:

1. How is the e-mail system similar to an expert system? How is it different?
2. What is likely to be the most difficult part of creating a system for handling your messages?

Category	Centralization	Decentralization
Hardware	Share data. Control purchases. Control usage. Less duplication. Efficient use of resources.	Less chance of total breakdown. Users get personalized machines.
Software	Compatibility. Bulk buying discounts. Easier training. Ease of maintenance.	Different user preferences. Easier access. Customization.
Data	Easy backup. Easier to share. Less duplication. Security control and monitoring.	Only transmit data that needs to be shared. Keeps user control and politics.
Personnel	Similar worker backgrounds. Easier training. Straightforward career path. Specialized staff. Easier to see and control costs.	Faster response to users. More time with users. Better understanding and communication. Different career path.

Figure 13.10

Summary of benefits of centralization and decentralization. There are advantages to both centralization and decentralization of the MIS resources. The ultimate objective is to design an MIS organization to benefit from as many of the advantages as possible by combining both centralization and decentralization.

access to data and services on distant computers. Central computer services became standardized and companies emphasized purchasing software (particularly ERP systems around 2000). Servers became cheaper and simpler to operate. Some companies outsourced many tasks, including server and network management. Decentralization created some security issues, so conflict often arose over control of data. By 2010, the pieces were in place for companies to re-centralize their operations by using Web servers and software as a service. Software and data could be stored on cloud-based servers with users accessing everything through browser-based platforms including tablets and cell phones. It remains to be seen whether this transfer to cloud-based computing will be a trend or simply a tool to support certain tasks.

Almost none of the issues of centralization and decentralization are new—politicians, economists, and organizational theorists have debated them for hundreds of years. The basic argument for **centralization** revolves around the need to coordinate activities and efficiencies that can be gained from large-scale operations. Proponents of **decentralization** argue that moving control to smaller units produces a more flexible system that can respond faster to market changes, encourage individual differences, and innovate. Figure 13.10 summarizes the arguments for centralization and decentralization.

As with many arguments, there are different answers for different circumstances, and it is rare that the extreme choices are best. Wise managers will attempt to gain the advantages of both approaches. With information systems, four basic areas are subject to centralization or decentralization: hardware, software, data, and staffing. Determining the best way to organize information resources requires that managers understand the advantages and disadvantages for each of these areas.

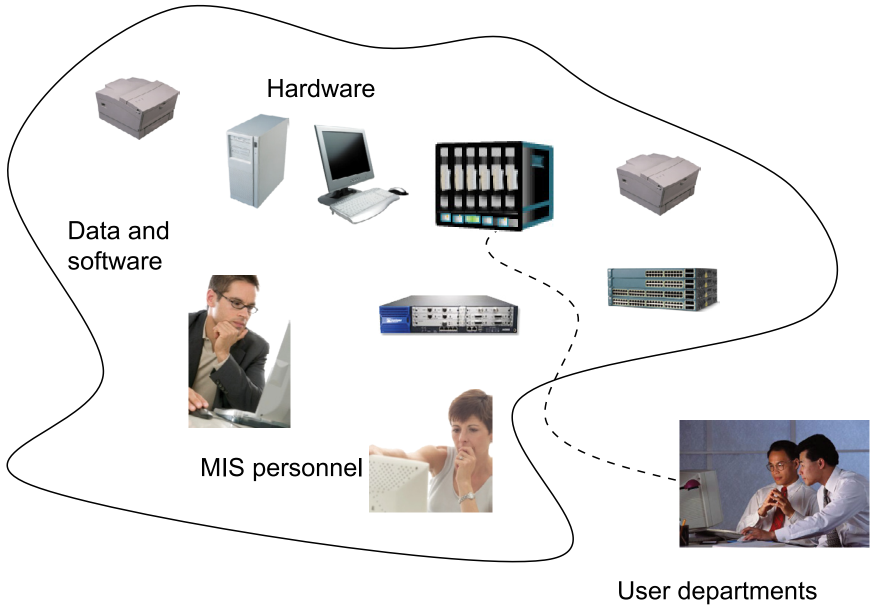


Figure 13.11

Complete centralization. For many years, computers were expensive and there were few communication networks. Consequently, hardware, data, software, and MIS personnel were centrally located. Data was sent to the computer for processing and printed reports were distributed throughout the company. Users only dealt indirectly with MIS.

Hardware

Today, hardware is relatively inexpensive. Even centralized servers have come down in cost, often using systems based on server farms consisting of hundreds or thousands of inexpensive computers.

Similarly, on the user side, prices of personal computers have dropped substantially. Even portable devices are relatively inexpensive.

Centralization

The biggest advantage of centralized IS hardware is that it is easier to share hardware, software, and data with multiple users. Complete centralization is shown in Figure 13.11. Consider a simple example. If a company installs an expensive printer in one user's office, it will be difficult for other users to get access to the printer. On the other hand, with only one central computer, all of the hardware, software, and data will be located in one place. All users can be given equal access to these facilities. By keeping all hardware, software, and personnel in one location, it is easier to avoid duplication and keep costs down.

Along the same lines, centralized hardware also makes it easier to control user access to the information system. By storing all data on one machine, it is easy to monitor usage of the data. In a sense, all user access to data must first be approved by the MIS department. Any data alteration or transfer is much easier to control if it takes place on one machine.

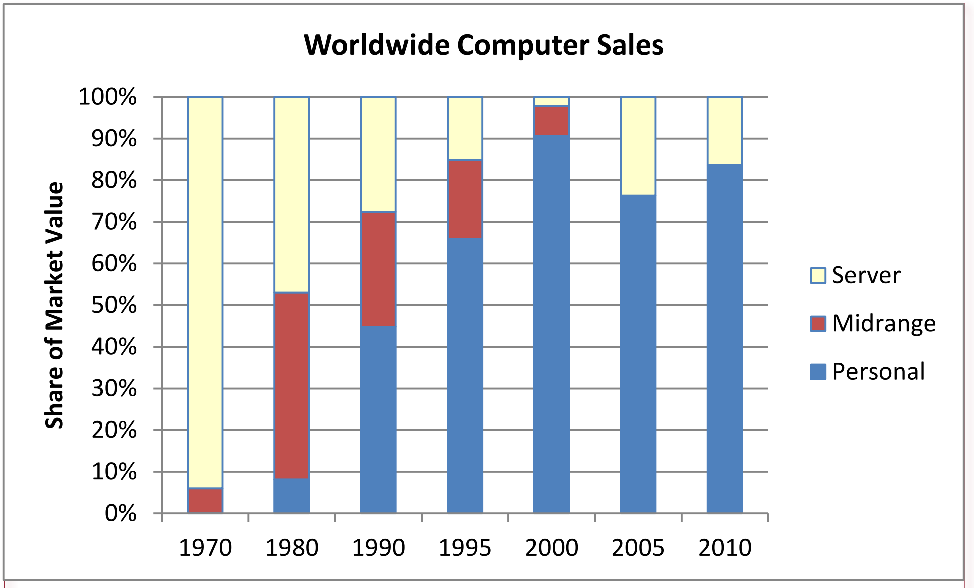


Figure 13.12

Growth of personal computers. The huge price and performance gains of PCs drove their adoption for 30 years. Although servers eventually adopted the same technologies, hardware became distributed throughout the organization.

Centralized purchasing can also be used to save money. It is easier to standardize equipment if it is all located in one place. It is generally possible to obtain discounts from vendors by buying larger quantities. Centralized purchases also make it easier to keep track of the amount of money spent on information technology. When user departments are responsible for all IT purchases, the lack of centralized control can lead to duplication of hardware.

Decentralization

Decentralization of hardware carries its own advantages. First, there is less chance of a total breakdown. If your computer breaks, everyone else can continue working. You might even be able to borrow someone else's machine. Figure 13.12 shows the huge adoption rates of personal computers. The lure of total control over powerful, low-cost computers led users to adopt them and use them for many computing tasks—particularly decision support analyses. During that time, spending on all computers, including servers, increased. But the growth of PC-spending vastly exceeded all others.

The PC technology eventually spread into servers, driving down their costs as well. Today, the differences between servers and personal computers are subtle; but some vendors such as IBM, Hewlett-Packard, and Sun sell specialty servers. Many of these servers are used for Web-based applications, so they do represent a return to centralization of hardware in some areas.

Figure 13.13 shows another way to look at hardware decentralization. It shows the growing shift to laptops, where even by count, laptop sales exceeded 50 percent of the shipments by 2009. The chart does not include Web-based cell phones or tablets. Some people are forecasting that sales of tablets will cut into the sales

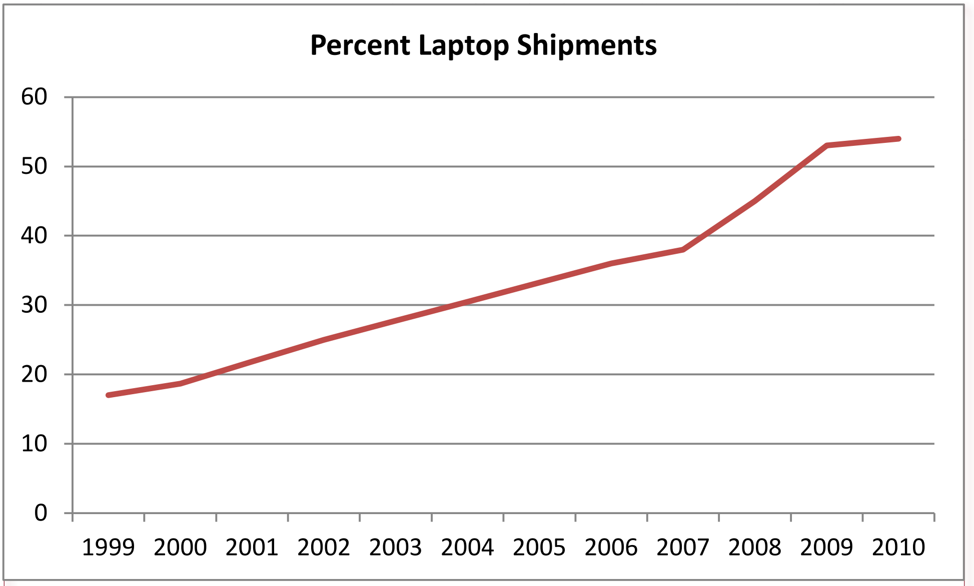


Figure 13.13

Mobile computing. Based on unit sales, laptops have become increasingly popular. Throw in tablets and computer-based cell phones and the extent of decentralization becomes greater.

If software applications are standardized and purchased centrally, it is possible to negotiate lower prices from software vendors. Besides, if everyone uses the same basic software, fewer compatibility problems arise and it is easy for users to exchange data with coworkers. Similarly, upgrades, training, and assistance are much simpler if there are a limited number of packages to support. Imagine the time and effort involved if the company needs to upgrade different spreadsheets on 5,000 separate machines. Some companies have reported that by the time they managed to upgrade the entire company, an even newer version was released.

Software Decentralization

Forcing users to choose identical packages can lead to major arguments between users and the MIS department. Many times users have different requirements or perhaps they simply have different preferences. If one group of users prefers the software that is different from the corporate standard, why should everyone in the company be forced to use the same tools? Cost becomes less of an issue as software prices drop. Support might be a problem, but major software packages today are similar. Data incompatibilities often can be resolved with conversion software.

To some extent, users should have the ability to customize their software to match their preferences. Today, most software packages enable users to choose colors, mouse or keyboard responsiveness, and locations to store personal files. If this software is moved to a centralized environment, you have to be careful to preserve this ability.

One complication with enabling users to choose different software is that it can be difficult to determine the configurations of each machine. If a user has a

Reality Bytes: Perfection is Probably Impossible even in the Cloud

One of the big risks of centralization is that if something goes wrong, individuals have little ability to recover data. Instead, the centralized provider is responsible for securing the data and providing backups. The cloud and virtual computers make this process easier, but few technologies are perfect. In February 2011, as many as 150,000 Gmail users faced the loss of years of data stored on Google's servers. One noted that "I logged in and my account also looks like a brand-new Gmail account! 10 years of emails (17000 of them) are gone." Google engineers worked for several days to restore the data. Ultimately, most of the data was restored—from old-style tape drives. The bottom line is that users should try to keep backup copies of their data. If it is not possible to store data on client systems, at least move copies of critical data to different online providers.

Adapted from Laurie Segall, "Google Nukes Thousands of Gmail Accounts," *CNN Online*, February 28, 2011.

problem, the MIS support person needs to know what software is installed on the machine. When installing new hardware and software, the support team needs to know what software exists on each target machine. Managers also need to track software usage when they purchase upgrades and to verify compliance with software licenses. Several software tools exist to help the MIS department track software usage and report on the configuration of each computer. A small file is installed on each computer that reports on the software, hardware, and configuration of each machine.

Data Centralization

The most important feature of centralized data is the ability to share it with other users. Large central servers were designed from the ground up to share data. They were designed to solve the problems of allowing concurrent access and to protect the integrity of the data. Similarly, they have security facilities that enable owners of the data to specify which users can and cannot have access to the data. Centralized systems also monitor access and usage of the data to prevent problems.

Another important feature of centralized data is the ease of making backups. When all databases are stored on one machine, a single operator can be hired to maintain daily backups. If data files are lost, it is easy to restore them from the backups. With the data on one machine, it is easy to ensure that all files are regularly backed up. Contrast this situation with distributed personal computers, where users are generally responsible for making their own backup copies. How often do you personally make backups? Every night?

Data Decentralization

The strongest advantage to decentralizing data is that it gives ownership of the data to the group that creates and maintains it. Users also have complete control of the data and can prevent anyone else from even knowing that it exists. For data that does not need to be shared, this control presents no problems. However, scattered control of data can interfere with other users when many people need access to the data. An example of complete decentralization—including data, hardware, and personnel—is displayed in Figure 13.14.

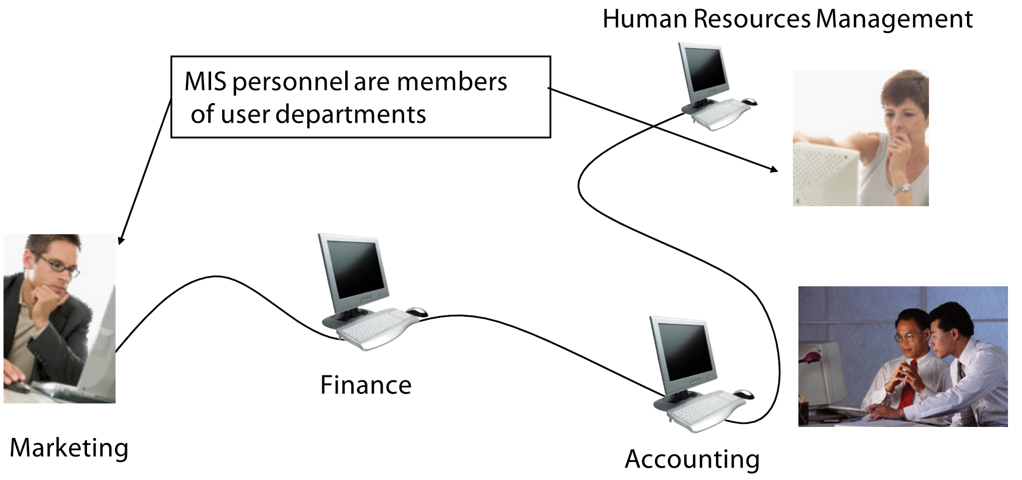


Figure 13.14

Complete decentralization. Each department maintains its own hardware, software, and data. Corporate standards and the network enable workers to utilize data across the company. MIS personnel are members of the user departments and support tasks within that department.

Data replication is sometimes used to provide the advantages of decentralized data—and still provide companywide access. With replication, the database is copied to multiple servers throughout the company. Users work on their local copies, which provide fast access to the data. The changes are copied to the other servers at regular intervals, so everyone has access to the latest data. This technique is often used with groupware products to distribute spreadsheets and word-processed documents.

Personnel

When most users think about decentralization, they often forget about the information systems personnel. Traditionally, the MIS roles have been performed by centralized MIS staffs. However, the increased decentralization of hardware increases pressures decentralize the personnel by having them report directly to user departments.

Centralization

Most of the advantages of a centralized MIS staff accrue to the MIS workers. For example, MIS workers often feel more comfortable with other MIS specialists. Centralization creates a group of homogeneous workers who share the same education and experiences. Moving MIS workers to user departments places them in a minority position.

One implication of this situation is seen by looking at the career path of an MIS worker. In a centralized environment, workers are typically hired as programmers. They eventually become systems analysts. Some move on to become team or project leaders, and a few can look forward to becoming managers of IS departments and perhaps a CIO someday. If programmers are moved to user departments (say, human resources), what career path do they have? Maybe they could become team leader or manager of the HRM department, but they would be competing with HRM specialists for those positions.

Centralization also makes it easier for the company to provide additional training to MIS staffers. Because hardware and software changes occur constantly, MIS employees need to continually learn new tools and techniques. If they are all located in a central facility, it is easy to set up training classes and informal meetings to discuss new technologies.

Centralization also gives the firm the ability to hire MIS specialists. If there are 50 positions available, two or three can be set aside for workers specializing in areas such as database administration or local area networks. If all workers are distributed to user areas, the individual departments will be less willing to pay for specialists.

Finally, when the entire MIS staff is centralized, it is easier to see how much MIS is costing the firm. If the MIS functions are dispersed to user departments, they may be performed on a part-time basis by various employees. It is difficult to control the costs and evaluate alternatives when you do not know how much is being spent.

Decentralization

The primary advantage to decentralized MIS staffing is that the support is closer to the users. As a result, they receive faster responses to questions and problems. More important, as the MIS staffers spend more time with the users, they gain a better understanding of the problems facing the users' department. Communication improves and problems are easier to identify and correct. These are powerful advantages to the individual departments and have the potential to create much better development and use of information systems.

The Help Desk

One issue with decentralized MIS support is that it can be expensive to place MIS personnel in each department. Many companies compromise by creating a help desk that is staffed by MIS employees who specialize in helping business managers. When business managers have questions, workers at the help desk provide answers. Typical problems involve personal computers, networks, and access to corporate databases. One advantage for business managers is that they do not have to search for answers—they simply call one number. This system can also cut costs and ensure consistent support. The knowledge of the support workers is easily shared throughout the company. It is also easier to train and evaluate the workers.

To provide more decentralized support, some companies are using their networks to provide more detailed help to business departments. They set up a special program in the background on each personal computer. When someone calls for help, the microcomputer specialist can see the user's screen and take control of the user's machine. This method simplifies communication between the user and the specialist, making it easier to solve problems and make changes immediately. Of course, it also raises several security issues, because the help desk personnel could monitor any machine at any time.

Recentralization with Cloud Computing

How can Internet technologies be used internally to centralize data but still support decentralized user access? No organization is

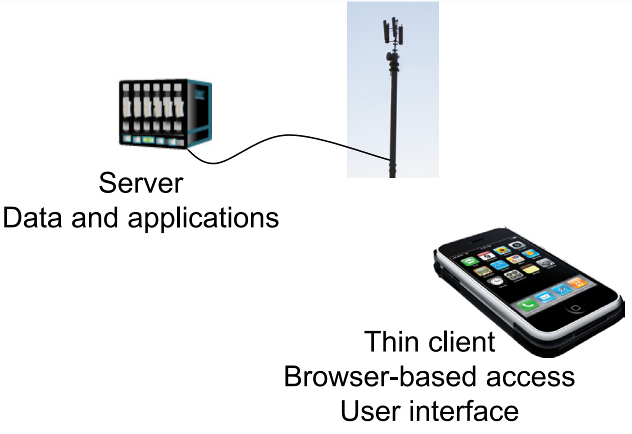


Figure 13.15

Thin client. The thin client device is only responsible for displaying data and translating user input. The data and the application software reside on the central servers.

completely centralized or completely decentralized. The true challenge is to create a system that matches the needs of the organization. Networks are a critical part of the solution. With reliable high-speed networks, data can be stored anywhere. But most organizations do not yet have high-speed networks everywhere. In particular, connections to offices in other cities or nations can be expensive and relatively slow. Consequently, bandwidth is a crucial factor in deciding centralization issues. Cloud computing and private clouds or Web-based intranets provide a solution to many of these problems.

Networks

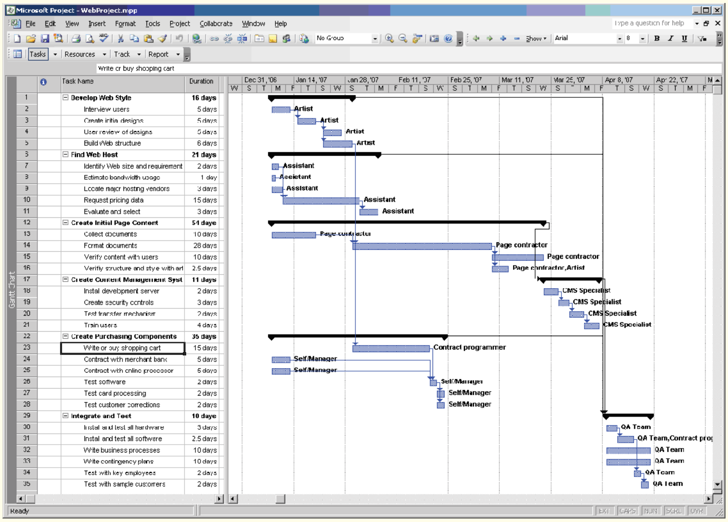
Web technologies are particularly good at handling low-bandwidth connections to users. Web browsers are relatively efficient at displaying data. Many business pages contain only basic data and graphs, which can be easily and quickly sent to managers. Streaming media technologies can be used to send more complex data, such as speeches, to many users at the same time—even when the managers are connected through dial-up lines.

The capabilities of the Internet browser have led firms to consider a new approach to organizing the MIS resources. The **thin-client** approach, illustrated in Figure 13.15, uses a relatively simple computer to run a Web browser that is responsible for displaying data and getting input from the user. This approach recentralizes many of the MIS functions. All of the data and most of the applications reside on centralized servers. The use of Web standards simplifies many decisions. Users can choose almost any type of client hardware, including laptops, tablets, and PDAs. As long as the system runs a browser, it can access the corporate data. Of course, some client computers will have more capabilities than others.

The browser client is becoming a user interface device, with responsibility for displaying data and translating input to a standard form. This approach simplifies the development of applications and provides more flexibility to users and organizations. For example, some users or entire organizations might stick with standard desktops for years to save money. Others might move to wireless-based

Technology Toolbox: Managing Projects

Problem: You need to track workers and schedules on a project.
Tools: Project management software such as Microsoft Project has becoming increasingly sophisticated.



The tools emphasize Gantt charts, but the primary strength is that all of the information is stored in a database. The tools quickly provide different views of the data, including Gantt, network, and critical path charts, calendars, and worker schedules.

The first step in any project is to identify the goal. Do you need to be finished by a specified date, or do you have a starting date and need to estimate the finish? The next step is the most important: break the project into multiple tasks. Tasks can be grouped and subdivided into even smaller activities for large projects. Each task should have a clear starting and ending point. For each task, estimate the amount of time required to complete the task. Later, you can record when tasks begin and track their progress. Once the basic tasks have been defined, you need to specify the relationships: Which tasks cannot be started until a prior task has finished? For example, you cannot begin integration testing of software until after it has been written.

You can also assign resources to each task. Generally, you will assign people or outside contractors to particular segments. If technology or other hard resources are going to be a limiting factor, you should include them as well. Microsoft Project has a system to automatically "level" the project if resources are over allocated. For example, if you are scheduled to do three daylong tasks on one day, it will push the tasks forward to provide a better estimate of when the project will be completed.

Most development projects involve multiple workers or contractors performing many tasks. Each task can be dependent on many other tasks. The Gantt chart highlights these dependencies. As the project progresses, you can add completion data to each task. If a task is delayed, the system will automatically push back the future tasks and show the new completion date.

Microsoft Project can also be integrated with a Web server, enabling each participant to check the progress and share calendars. The Web server acts as a groupware tool and can e-mail each person and record their comments.

Quick Quiz:

1. What advantages are provided by storing the project information in a DBMS?
2. Why is estimating development time one of the most difficult activities?

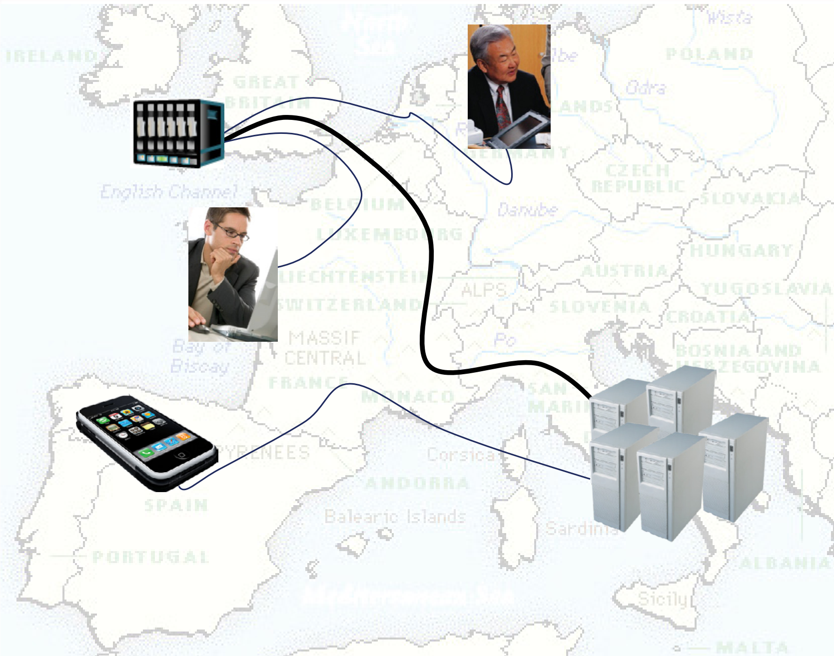


Figure 13.16

Intranet networks. Server locations are connected by high-bandwidth networks to replicate data. Individual users obtain data using standard Internet connections.

tablets or Web-enabled cell phones that rely on voice input instead of keyboards. The key point is that the choice of the user device should no longer matter to the application developer. Regardless of the user device, the back-end databases are the same, the Web servers are the same, and the applications are the same. Note that currently, it does take a middle-ware component to strip down Web sites so that they are small enough for today's cell phones, but that limitation is likely to change in the near future. The simplicity of this approach is that it recentralizes the primary items that gain from centralization: the main business applications and the shared data. Users are free to use whatever devices they prefer and to load additional software on their computers. A key benefit of the thin-client approach is that the clients can be built from relatively simple hardware and software, reducing the cost and improving the reliability of the clients. With fewer problems, user support becomes easier and cheaper.

As cloud-based computing software expands and improves, it will become easier to move more applications to cellphones and tablets. For example, Google and Microsoft both have Web-based personal productivity suites. Other companies provide installable apps that can be used to open and edit standard Word and Excel files on tablets.

One challenge is that large data transfers require high-speed connections. For example, bulk data transfers from one division to another will suffer if sent over dial-up lines. Since high-bandwidth Internet connections are expensive, companies will cluster their servers in a few key locations. As shown in Figure 13.16, these server locations will be connected with high-speed lines, and everyone else will use lower-priced basic services to connect over the Internet.

Reality Bytes: How Do You Know if Your IT Department is Working?

Shortly after Obama took office in 2009, the administration began planning to reduce the number of government data centers—largely to reduce costs. First, it had to figure out how many federal data centers existed. In 2011, the administration announced plans to shut down 137 of the 2,094 centers it identified. The plan ultimately targeted 800 centers to be closed by 2015. The plan estimates it will save $3 billion a year. The government spends about $450 million a year just on electricity to run the centers. Because of overbuilding, the White House estimated only 27 percent of center capacity was utilized—far lower than average values for private-sector data centers. In mid-April, while Obama was at a fundraiser in Chicago, a microphone was left operational and some off-the-cuff remarks were widely reported. Mostly, Obama complained about government IT support, calling it "horrible," across the board, including the Pentagon, Homeland Security, and federal agencies. Mark Knoller, a reporter for CBS who heard the comments tweeted that "Obama said he thought that as president, he'd have some 'cool phones and stuff' in the Oval Office, but now he says 'we can't get our phones to work!'" More publicly, Vivek Kundra, the federal CIO, has been critical of federal IT, noting that "projects too often cost more than they should, take longer than necessary to deploy, and fdeliver solutions that do not meet our business needs."

Adapted from Damian Paletta, "Government to Pull Plug on 137 Data Centers," *The Wall Street Journal*, April 27, 2011; and Patrick Thibodeau, "Obama Unvarnished: Government IT is 'Horrible'," *Computerworld*, April 15, 2011.

The network personnel still have to decide where to locate the servers and which data should be stored on each server. Many systems use data **replication**, where each server location holds the same data. Data changes are exchanged on a regular basis, often overnight, so each server has a relatively up-to-date copy of the data. The MIS department is responsible for maintaining the servers and the networks.

Hardware

Companies have several choices for the central server hardware. But the software environment is more important than the specific hardware. The servers need to run software that generates the Web data while interacting with the database management system. Several companies offer competing technologies for these services that run on diverse hardware platforms. The main issues are (1) cost, (2) scalability of the servers so that the system can be expanded without interfering with existing operations, and (3) reliability, maintainability, and backups to ensure the systems can remain operational at all times.

Data

Because of the challenges of running and securing servers, most companies lean toward centralizing the data. Certainly the basic financial data is consolidated in a data warehouse. This approach works well for managers retrieving data for analysis. The main problems arise in terms of creating or modifying the data. The workers who create and analyze the data to produce more useful information need more sophisticated tools. They also need greater access to the data, compared with users who simply view the data.

Reality Bytes: Minimizing Complexity with Thin Clients

The Co-operative Group runs a chain of grocery stores in Manchester, England. The company was in the process of building new corporate offices and asked its IT technical architect, Ian Cawson, to establish a new PC policy before the building opened in 2012. He determined there was not enough time to conduct a full business analysis, so he selected a thin-client approach using Wyse hardware for 2,500 of the office's 2,750 users. All of the PCs are created as virtual desktops in the central server. He also plans to roll out the system to the 19,000 users in offices worldwide in three to five years. Overall, Cawson notes that the approach does not really save costs. Instead, it makes it easier to manage things like upgrades and patches. Users will also be able to access their desktops from portable devices, such as the Apple iPad.

Adapted from Robert L. Mitchell, "Grocer Goes with Thin Clients," *Computerworld*, May 3, 2011.

Giving users, even managers, the ability to create new data scares most MIS people. The security challenges are much greater when users need to add and change data. It is more difficult to control access and ensure that only authorized people can make the changes. Plus, if something goes wrong, the IS employee is the one who will be blamed. In the old days of simple transaction data, it was relatively straightforward to set up controls and procedures for the daily operations. And it was reasonably simple to keep transaction logs of all the changes so errors could be corrected. But in today's environment, teams of workers perform the analyses and information creation, so team members need access to work in progress. For instance, the financial budgeting team uses the marketing and production forecasts to generate estimates of future cash flows.

From the standpoint of data creation, the cloud approach requires two steps beyond traditional systems: (1) managers need tools that will create the final data and reports in a format suitable for the browsers, and (2) managers need an easy method to securely transfer information to the servers.

Better data creation tools have been created in the past few years, but in many cases they are still hard to use and can require specialized training. Likewise, several systems have been created to simplify transferring data to cloud-based servers. Some are relatively easy to use. As always, the challenge lies in providing security so that the transfer process is easy for authorized managers but impossible (or exceedingly difficult) for unauthorized users. Both of these conditions require that managers have more powerful tools and often higher-speed data connections. Managers will also need more support and technical assistance. Hence, portions of the MIS organization must be decentralized to handle these issues.

Conflict Management

Why is the MIS department involved in so many conflicts? How do you solve them? The answer to the first question should be relatively easy if you reread the sections on centralization and decentralization. Trying to resolve the issues is considerably more difficult because each organization is different. An answer that is often popular is to fire the CIO. But that rarely solves the underlying problems.

Reality Bytes: Outsourcing Politics at Infosys Technologies

Many politicians have found it useful to pound the drum about outsourcing firms taking away American jobs. As with most issues of international trade, the politicians are ignorant of the economics, such as reduced costs and higher profits for American firms. But, in August 2010, they substantially increased the fees for skilled employment visas—making it more expensive for Indian firms to place their employees in U.S. jobs. In 2011, U.S. agencies began investigating one of them (Infosys Technologies Ltd.) for possible abuse of the temporary business visa program. Essentially, the Indian firms send their employees to U.S. businesses to handle tasks such as business analysis. Indian firms reportedly earn about 60 percent of their total $50 billion in annual revenue from U.S. firms. Infosys was accused by a former employee of using short-term B1 visas to bring in employees to work on a long-term basis. Long-term employment requires an H-1B visa, which are more tightly controlled. In the past, the annual limit for H-1B visas was often reached within a few weeks of the start of the annual time period.

Adapted from Magha Bahree and Amol Sharma, "U.S. Moves from Rhetoric to Action on Visas," *India Realtime*, May 25, 2011.

Centralization and decentralization are often causes of conflicts. Managers want the flexibility to respond to the changing environment. They often are willing to implement technology that helps them directly. But they rarely want to pay for the technology, and they generally dislike having to pay for infrastructure technology. The CIO and the MIS department provide and support IT, but they are usually squeezed by costs. Software and employee costs increase. Although hardware costs are declining, it simply means that organizations buy more hardware, and installing more hardware means more work. Leading edge MIS departments automate as many of the tasks as possible, from software installation to support to network monitoring. One way MIS departments try to reduce costs is to standardize as much of the technology as possible. The company purchases one machine and configures it the same for all users. Users are forbidden from customizing or adding any software or hardware. While this approach makes life easier for MIS, it does restrict the technology and applications available to the company. What is the goal of the company: To make life easier for MIS or to use technology to improve the business? At what cost? The issues are further complicated because no one really knows if the MIS department is efficient or wasting money. Hence, firms have an incentive to look at outsourcing—to provide a market price comparison.

The conflicts get even worse as MIS becomes more focused on security. Many restrictions have been imposed in the name of security. Yes, security is important, but remember that security requires a trade-off. For example, it is possible to "protect" a document so that it is 100 percent secure: all you have to do is completely destroy the document (and any copies). This action guarantees that no one can steal or read the document. But it also ensures that you cannot use the document. By definition, security creates this trade off, which pretty much guarantees there will be conflicts between the central security managers and the rest of the organization. Keep in mind that computer security people lose their jobs if someone breaks into the computers and steals data and money. They rarely get fired if their security controls force users to take 20 more steps to finish a job. Consequently, security administrators tend to lean on the tighter side of security—even when it creates additional problems and work for users.

The answer to resolving these conflicts is to understand that they will arise and to build a mechanism to resolve the disputes. You could escalate all disputes to the level of the CIO or the board of directors, but that would waste an incredible amount of time. It is far better to establish a neutral oversight committee to evaluate MIS progress and arbitrate conflicts. Just make sure the committee is chaired by a business leader and not an MIS manager.

Summary

Managing an MIS organization is difficult. Even as a business manager, working with MIS and choosing the proper role for technology can be challenging. Ideally, the goals of the MIS department should be aligned with the overall business goals. But with issues of centralization, cost control, and security staring you in the face, conflicts can easily arise. One of the more difficult problems facing MIS departments and company executives is the conflict between centralization and decentralization. These issues were involved in many decisions during the last 5 to 10 years, from politics to corporate organizations, to the way in which MIS fits into the organization. Although there is no single answer that applies to all situations, there has been a distinct trend during the last few years toward decentralization. In larger organizations, this propensity has been hampered by the highly centralized organizations and computer systems that have been in place for the last 30 years.

Decentralization of MIS can occur in any of four areas: hardware, software, data, and MIS personnel. Economics is driving the decentralization of hardware, because of tremendous price performance values in personal computers. The challenge is to accommodate this decentralization without losing the benefits of centralization. One option would be a completely decentralized information system, where each user and department is responsible for its own information. Today, the Internet standards provide new technologies to gain the benefits of both centralization and decentralization. Applications running on Web servers can retrieve centralized data to be displayed and modified using thin-client browsers. The goal is to gain the economies of scale and improved control and ease of sharing offered by centralized servers, yet provide users with the individual tools needed to perform their jobs. The simpler client hardware and software platforms offer the promise of less user support.

Managing servers and networks, as well as building applications, can be difficult tasks for many companies. It is hard to find and reward good IS workers, and continually solving technical problems takes time away from the daily business tasks. So, many organizations have chosen to outsource various IS functions—from development to maintenance to development and operation of the servers. Outsourcing provides a short-term increase in cash for the company, access to computer specialists, and the ability to concentrate on the company's primary business. However, firms requiring specialized talent, high security and control, high levels of recent technology, new state-of-the-art information technology, or complex market structures should avoid outsourcing and retain in-house management of the information function.

A Manager's View

It is difficult to manage and evaluate an MIS organization. With multiple roles and many different types of employees, IT departments can be expensive. You can try to use outsourcing and contractors to reduce costs. Ultimately, you have to decide on the strategic role of MIS. Is cost reduction your primary goal, or are you going to use technology to improve the business and gain a competitive advantage? Centralization and decentralization are key issues in managing information systems. Many conflicts arise when the IS departments are not aligned with the business practices. New Web-based technologies offer new methods of maintaining the cost advantages of centralization while still providing decentralized user access and control.

Key Words

advocacy role
centralization
certifications
chargeback
data administrator
data integrity
database administrator
decentralization
offshoring
outsourcing
replication
service level agreement (SLA)
standards
systems analyst
thin client
total cost of ownership (TCO)

Web Site References

Job Boards	
Careerbuilder	www.careerbuilder.com
Computerworld	www.computerworld.com/topic/10/Careers
Dice	www.dice.com
Jobs.com	www.jobs.com
Kforce.com	www.kforce.com
Monster	www.monster.com
Studentjobs.gov	www.usajobs.gov/studentjobs
U.S. Government	www.usajobs.gov
Wall Street Journal	careers.wsj.com

Review Questions

1. What are the main issues in managing an MIS department?
2. What are the basic roles of the MIS department?
3. What types of MIS jobs are available?
4. How do you determine which aspects of MIS to outsource and which to keep in-house?
5. Is it true that students should avoid IT careers because all of the jobs are moving to other countries?
6. Even if a company has an ERP system and buys most of its software, what aspects of MIS does it need to keep?
7. What are the advantages of centralizing computer hardware, software, and data? What are the advantages of decentralization?
8. Why do different types of organizations require different levels of IT centralization?
9. How do Web-based operations solve the centralization/decentralization problems? Do they make some problems worse?
10. Why do conflicts arise with MIS and what structures should be created to help resolve them?

Exercises

1. Using salary surveys and local advertisements, find typical salaries for various MIS jobs in your area.
2. Interview a worker at a large company (perhaps a friend or relative) and ask them to evaluate the MIS department. Comment on the degree of centralization. Does the organization use chargeback to pay for MIS services?
3. Make a list of symptoms you expect to see in a company that is "too decentralized." That is, company users are free to choose any hardware and software, and databases are maintained by each department. Data is shared through reports that are printed in each department and forwarded to other departments on paper. There is no central MIS staff and no CIO. Treat it as a company that started small using personal computers and grew but did not come up with a centralized information system approach.
4. As a manager in a small company, you do not have an in-house MIS development team. You need a special data-analysis program created that will run as a browser-based service on your Web site to help other managers analyze sales data. The mathematical analysis is fairly complex, but you have formulas for all of the calculations. Find a company or person that could handle the development for you.
5. Find data on the number of computer science and MIS majors at your school for the past few years and identify any trends. How might these trends affect the job market?

6. Obtain a sample of at least 20 job ads for programmers. For example, randomly sample ads from Dice or Monster. Summarize the programming languages and skills in demand. Identify the types of companies hiring workers. In particular, are they general business organizations, or are they MIS development specialists?
7. Using the various salary surveys, compare salaries for small versus large businesses in your area. Briefly explain the differences. If possible, talk with employees at small and large businesses to see how the jobs might differ.
8. Using the Web, find at least three job descriptions for MIS workers in network support. Summarize the main tasks of the job and explain how they support the company.
9. Browse the online contract-worker site vworker.com and examine at least five project descriptions. Summarize the projects and comment on the level of detail provided and the suggested values.
10. Choose a case in this book and explain the level of centralization within the management of the company.

Technology Toolbox

11. Assuming that you work as a manager, create a set of mailbox folders to handle your expected mail. Create the rules that will move incoming mail to the appropriate folder.
12. Assuming that you are in charge of a sales division for a large company, create an e-mail rule to handle messages from customers. You have a couple of key clients that you have known for years, and they have a pattern of sending messages. For example, they send personal messages a few times a year, they send questions about price changes monthly, and once in a while they send complaints about late deliveries or quality concerns. Sometimes they send a new order directly to you, which you have to forward to the sales staff.
13. Create a project management analysis for starting a new company. Identify the major tasks and their dependencies. If possible, create the project in Microsoft Project (you can get a free demonstration copy). If it is not available, at least draw a Gantt chart by hand.
14. Create the Gantt chart for the development exercise using Microsoft Project. Assign resources at 100 percent as indicated and use resource leveling to determine the time it will take to complete the project.

	Task	Length	Depends on	Resources
1	Feasibility Statement	5 days		
2	Get hardware list and costs	1 day		Analyst
3	Count forms and reports	1 day		Analyst
4	Estimate development time	1 day		Analyst
5	Get benefits from user	1 day		Analyst
6	Create statement	1 day	2, 3, 4, 5	Analyst
7	Management Approval	1 day	1	
8	Analysis	17 days	7	
9	Interview users	7 days		Analyst
10	Evaluate competition	3 days		Analyst
11	Search for existing software	3 days		Analyst
12	Evaluate options	4 days	9, 10, 11	Analyst
13	Management Approval	1 day	8	
14	Design	15 days	13	
15	Design and create database	2 days		Analyst
16	Build forms	8 days	15	Programmer
17	Create reports	4 days	15	Programmer
18	Design application	3 days		Programmer
19	User approval	1 day	14	
20	Management approval	1 day	19	
21	Implementation	10 days	20	
22	Purchase hardware	2 days		Analyst
23	Transfer data	3 days	22	Programmer
24	Integration test	4 days	23	Programmer
25	Train users	1 day		Trainer
26	Write procedures	1 day		Analyst
27	Transfer operations	1 day	24	Analyst, Programmer
28	Review	1 day		Analyst, Programmer

15. Using the data in the previous exercise, explore ways to complete the project earlier. Note that you can consider hiring more people, but there is a limit—adding more people to the project means you have to add more managers and increase some of the development times to compensate for the additional overhead.

Teamwork

16. Interview computer users and managers in a local firm (or your university) and determine the degree of decentralization in their information system organization. Talk to several users and see whether their perceptions agree. Are they receiving all of the advantages of centralization and decentralization? If not, how could the system be modified to gain these benefits without significantly increasing the drawbacks? Be sure to analyze hardware, software, data, and personnel.

17. Have each person select one country and find the average cost for programmers. Identify technology and telecommunication capabilities available. Identify social and cultural factors (such as education) that could affect programming abilities. Combine the data from each person and identify a nation in which you would want to establish an offshore outsourcing facility.

18. Have each person research a separate case in the textbook and identify the degree of MIS centralization within the organization. Compare the results along with the sizes of the organizations. Identify any patterns.

19. Assume that you want to install a new wireless network for a company with 300 employees in one location. Find at least three companies that could handle the installation and configuration.

20. Assuming that the team is a company that needs to standardize its technology, select a single smart phone that would be used by each person and choose a standardized list of applications that would be available. If you had to use this corporate phone, would you give up your personal phone?

21. The team wants to start a company that provides business advice that uses the Web and smart phone applications. For example, it might specialize in answering marketing questions and analyzing sales data. Assuming the company grows to 50 main employees, describe the IT systems and organization that will be needed.

Rolling Thunder Database

22. From a management perspective, explain if Rolling Thunder Bicycles is a centralized or decentralized company.

23. How should the company handle typical information system tasks such as backing up data, creating employee accounts, maintaining hardware, selecting new hardware and software, and so on?

24. The company wants to move the entire application to a Web-based system to support both internal operations and allow customers to place orders online. Find a company that can develop the software. Find a company that can host the application. If possible, estimate the costs.

25. Assume users are complaining about lack of support from the MIS department. How can you improve MIS responsiveness? How can you do it without substantially raising costs?

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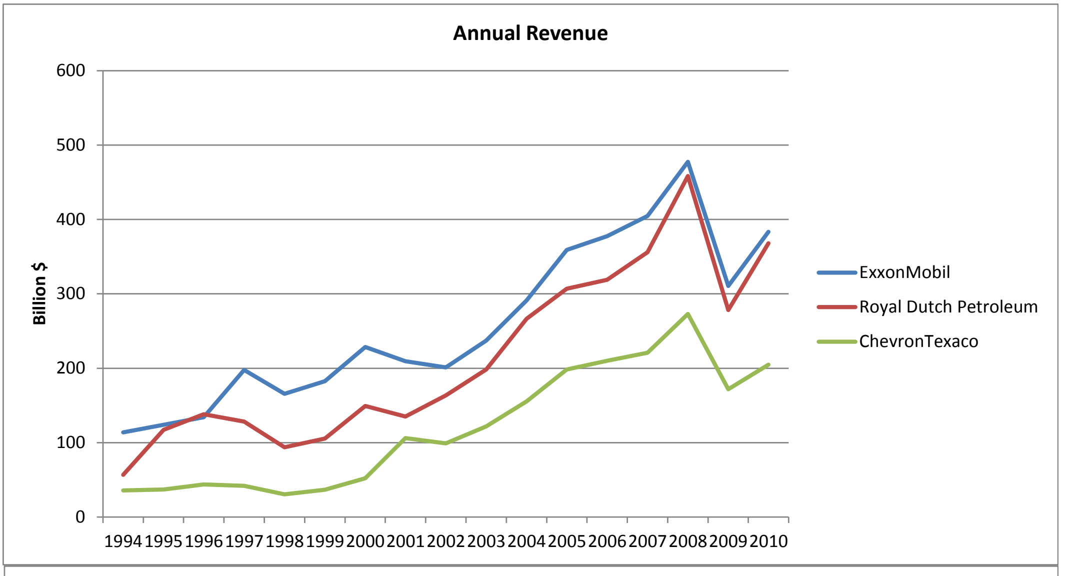
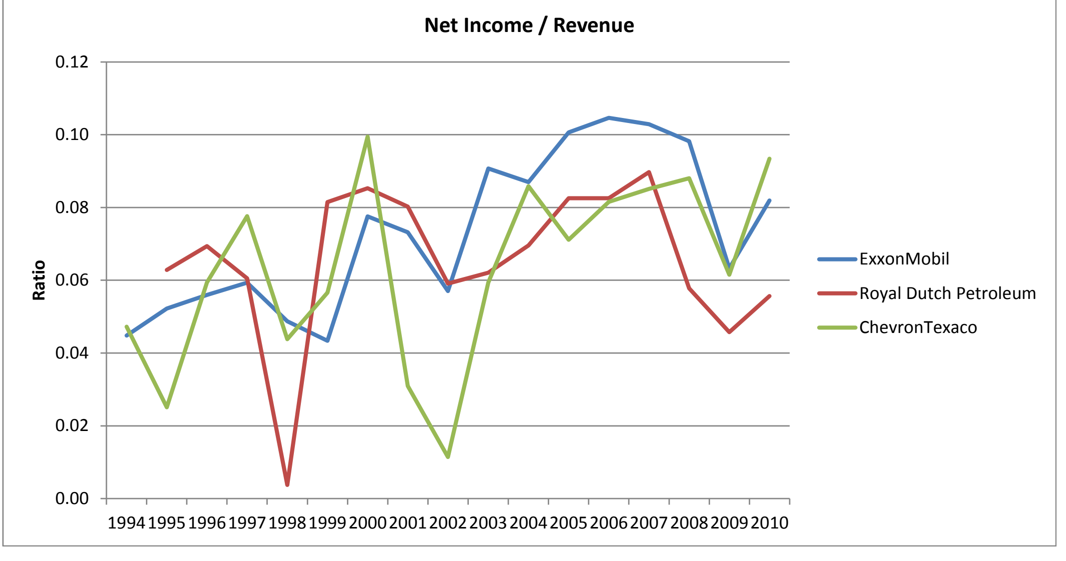
Cases: The Energy Industry

The Industry





How do you control a huge organization geographically dispersed around the world? How do you choose and implement information technology to help workers perform tasks from simple communication to advanced nonlinear analysis of seismic data? Then what happens when you merge two of these huge companies? Check the petroleum industry for different answers to these questions. The BP/Amoco, Exxon/Mobil, Chevron/Texaco, and Conoco/Phillips mergers of the late 1990s and early 2000s represented giant combinations. The mergers resulted in lower administrative costs. But they also made it more important to combine data and standardize processes across the new organizations.

The industry is also facing an eventual shortage of expertise, as the few industry experts retire. Many of the firms are turning to technology to leverage the knowledge of these workers. Communication technologies and high-resolution digital cameras make it possible for experts to diagnose problems remotely, reducing travel time. A few companies are experimenting with expert systems and knowledge management to store the accumulated knowledge of the experts.

Exploration

The energy sector contains a variety of companies and some interesting interrelationships and partnerships. The upstream process of oil exploration is notoriously variable. The exploration companies perform enormous data collection and analysis operations around the world. When oil prices are high, their services are in high demand. To spread the risk most of the exploration companies are independent and provide services to all of the major petroleum companies. But that means rivals end up sharing data on some projects. Analytical tools that have been refined and improved over the years can provide a competitive advantage to a large company, so they are cautious about sharing techniques.

The exploration companies—such as Amerada Hess, Anadarko, and Schlumberger—work around the world. They invest billions of dollars in both mechanical and information technology. According to the Energy Department, the total cost of finding and producing a barrel of oil dropped from $15 in 1977 to $5 in 2001—primarily due to improved technology (Ricadela 2002). Randall Nottingham, an analyst at Strategy Analytics, says that the oil industry spends $9 billion a year on IT, not counting the oil field technology and robotics (Ricadela 2002).

The oil exploration side of the business generates petabyes of data. All major oil fields and potential fields around the globe have been examined with seismic sensors. Producing fields generate even more data collection. Amerada Hess has 100 terabytes of data in its Houston center alone. All of it is refined and analyzed through complex geological models. These models are proprietary to the various research firms. They require huge amounts of computational power. Mike Heagney, Sun's global energy manager says that "oil companies are probably second to NASA in data volumes. The systems still aren't fast enough; they consume pretty much anything we put out" (Ricadela 2002).

To process that much data, Sun sells 106-unit server farms. IBM sells its monster symmetric processor systems as well as giant Linux cluster grids. John Sherman, executive vice president of marketing and systems for Landmark (a division of Halliburton), observes that "what we're trying to do in essence is look down in the earth. These [systems] are MRIs on supersteroids" (Weil 2002). Amerada Hess also employs a 200-node Dell cluster to run the huge analytical jobs. The PC-based systems cost about 10 percent of the price of the large IBM systems. A few companies perform the analysis as outsourcers—but the analytical tools are shared across the industry, reducing the competitive value.

Refineries

Refineries are some of the most complex chemical and mechanical systems in existence. Much of the systems are monitored and controlled through remote sensors coupled to computer systems. But the systems still need to be monitored by humans. It is critical to catch and repair a component before it fails. If something small fails, it can easily wipe out other components down the line.

Houston-based SAT corporation created a portable electronic system that managers can use to diagnose problems. Each component is given an RFID tag. Workers carry handheld computers that read the tag and provide device-specific data to check. For example, workers might be told to check the temperature, pressure, and vibration on a pump. The handheld expert system then provides instructions on what to do if problems exist. Bill Johnson, reliability manager at Lyondell-Citgo Refining LP, notes that "this thing will prompt some action. It allows us to identify problems earlier and do better troubleshooting when we identify those problems" (Thibodeau 2004). The data is eventually uploaded to the main computers to check for trends over time.

Because oil is so important to the current U.S. economy, the government and the firms are concerned about security from terrorists. Along with enhanced physical security measures, the companies are trying to create some type of network to help them share data and identify trends and threats. Protecting the IT infrastructure used to find and produce oil is also important. The main oil and gas companies have created the Energy Information Sharing and Analysis Center (ISAC). Users or outsiders can post warnings on the system. These warnings are analyzed and then threat notices are sent to the member companies.

The process is not that simple for the oil companies themselves. Mark Evans, CIO at Tesoro Petroleum Inc., notes that it is hard to retrieve information from the Supervisory Control and Data Acquisition (SCDA) systems that run the operations at most companies. "For a long time, we've been unable to share that information within our own company. That's really the first step" (Meehan 2002). Ultimately, the companies want to share security tips and best-practices information as well as notices of immediate threats.

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Case: ExxonMobil

ExxonMobil (ticker: XOM) is the largest of the newly combined oil companies. With over $370 billion in revenue and more than 83,000 employees in 2010, it is the second largest company in the United States. The company is involved in all aspects of oil production and marketing, from exploration to refining, chemicals, and distribution and marketing. The company has several proprietary software tools to help find and analyze deposits, including its Stellar basin-modeling software (www.exxonmobil.com).

The oil glut of the late 1990s and early 2000s drove crude oil prices down to $10 a barrel, a number that quickly became nostalgic after the $40 and $50 a barrel prices in 2004 during the Iraq war, followed by the $90-100-120 prices later in the decade. The unusual aspect to the price surge is that the oil companies have not dramatically expanded their exploration and production. In the past, companies would instantly respond to price signals, and the eventual increase in production would lead to a drop in prices. In 2003, Exxon's spending on exploration and production rose by 15 percent, but was flat through 2004 (Warren 2004a). One of the big questions is whether oil prices will remain high. The firms must forecast the price of oil for the near future.

With businesses in 200 countries, ExxonMobile relies on a suite of software representing best practices to reduce the complexity of its information systems. Patricia C. Hewlett, vice president of global information technology, said the IT organization has developed an "upstream suitcase," or collection of tools that can be installed when the company moves into a new market. The system includes the ERP system, tools to monitor equipment, track personnel, and manage work permits. "It's a suite of standard computing applications we can use anywhere in the world," she said. She also noted that the standardized package enabled the company to reduce staffing by about 15,000 employees after the merger. Exxon is one of the world's largest users of SAP, and it took considerable effort to install the system. But Hewlett observed that "it helped improve the quality and timeliness of data, and we've gotten even greater benefits than forecast." In terms of technology, the company does experiment with some leading edge ideas, but it sticks with standard, well-tested applications for systems that directly affect operations and productivity (Mitchell 2006a).

With its huge size, global reach, and thousands of employees, ExxonMobile wanted to create an identity-management system to simplify user logins and better control access rights. But, in 2006 when the company began testing various products, Ms. Hewlett found that they could not scale up to the needs of ExxonMobile. She noted that "available products could handle a small number of static roles but were not well suited to managing dynamic, attribute-base roles." The company also found that even though tools such as Microsoft's Active Directory could track users and roles, none of the company's applications were designed for roles—so they all needed to be rewritten. The project was put on hold until some of the problems could be resolved (Mitchell 2006b).

Merger

Exxon's takeover of Mobil was a major milestone both for the industry and for the IT department. SAP was chosen as the main financial IT platform. Both companies had been running SAP software, but they were separate global systems and required changes so that the final system was using a single set of accounts and definitions. Plus, Mobil had only begun its conversion to SAP a few months before the takeover. Since the takeover occurred shortly before 2000, both IT departments were also busy working on Y2K updates (King 1998).

To promote competition, the FTC required the two firms to divest 2,431 gas stations in the United States. Mobil had more than 3,500 stations configured to use its Speedpass RFID system. Waving the key-ring device in front of the pump triggers the system to access the customer's credit record and authorize the charge via satellite. The newly joined IT system also had to install the system in the merged stores (Hamblen 1999).

In 2000, the company announced that it was implementing mySAP for all of its employees. mySAP is a Web-based platform that provides links into the company's main databases. A key goal was to integrate all of the data and provide a consistent interface. Suzanne McCarron, an ExxonMobil spokesperson, notes that "by consolidating and upgrading our systems, we will streamline our business processes, lower information system support costs and provide access to common consistent data—all of which will result in overall cost savings, rapid information technology project implementations and improved performance" (Songini 2000). The system provides access to supply chain management, plant maintenance, human resource, and accounting tools. It also contains industry-specific oil and gas applications. In particular, the specific functions include dispatch planning and optimization and inventory management. In terms of profits, the higher prices for exploration and production added to Exxon's profits. However, the increase in price at the pumps caused consumers to cut back on driving, reducing sales volume (Cummins and Warren 2004).

The oil business is closely tied to politics in many countries—which considerably increases the risks. In 2003, Exxon was in talks to invest in Russian oil fields through Russian oil baron Mikhail Khodorkovsky. Exxon would love to gain a foothold in the Russian oil production industry. Unfortunately for Exxon, Khodorkovsky was arrested and imprisoned before any deals could be reached. Russian president Putin charged Khodorkovsky with failing to pay taxes and had him arrested. Many observers believe Putin was more concerned about Khodorkovsky's political ambitions (White, Whalen, and Warren 2004).

Research and Development

Finding new oil fields or even mapping the extent of existing fields is a difficult problem—particularly when the fields are in hostile environments such as the artic or deep sea. The oil companies have relied on seismic surveys and drilling for years, and many experts have decided that no new easy oil reserves exist. Faced with relatively low prices and stiff competition, many oil firms cut back on research and development in the late 1990s and early 2000s. Harry Longwell, an executive vice president at ExxonMobile took a different perspective and launched a program in 1996 to try new ideas and find new ways to search for oil. The concept of using electromagnetic systems to search for oil has been around for years, but no one had been able to make it work. Funded by ExxonMobile, Dr. Len Srnka found a way to search for oil deposits in deep-sea areas—locations that cost millions of dollars to drop a well. The technology makes it easier to find the specific location of oil deposits, providing an accurate target for drilling (Warren 2004b).

In 2006, the organization had more than 2 petabytes of operational data online. Most of the data involves operations, including refinery and production facilities. The company wants to build a knowledge management system to reduce duplication, index everything, and make it available for decision-makers (Mitchell 2006).

Questions

1. What benefits did ExxonMobil gain by centralizing on SAP's ERP software?
2. How does ExxonMobil use technology to reduce costs?
3. What information technology problems can ExxonMobil expect if it tries to expand into Russia?

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Case: Royal Dutch Petroleum (Shell)

Royal Dutch Petroleum (ticker: RD) is the main holding company for Shell Oil. It is headquartered in the Netherlands. The company did not participate as heavily in the late 20th century mergers. Still, in 2010, it had sales of about $368 billion and 97,000 employees. Note that the number of employees had been increasing, compared to the declining number of employees at ExxonMobile, but it did drop from 2009 to 2010. The company experienced a major public relations setback in 2004 when it was forced to restate its financial data for 2002 and 2003. The change was driven by an admission from Shell officials that they had overstated the company’s oil and gas reserves by 22 percent. Four senior executives were fired as a result of the misstated information (Wang 2004). The company has fallen behind the other major producers in developing reserve fields. In 2004, Shell began pushing more money into exploration. Malcolm Brinded, head of exploration and production, said that he was going to focus on high-margin projects in the UK and the United States. The goal is to “re-establish the competitiveness of the portfolio” (Cummins and Warren 2004).

Shell spends a considerable amount of money on hiring temporary workers, as much as $100 million a year. Most of the departments used a homemade collection of paperwork to hire, track, and pay the workers. The company was working with 20 different organizations that supplied contract labor and needed to cut its costs. Shell reduced its outside service providers to four and then installed software from IQNavigator. The system automates most of the processes needed to hire, track, and pay the temporary workers. By consolidating the information, Shell can negotiate longer-term and volume discounts with the main suppliers. To cut costs even more, the outside suppliers are the ones who pay for the software, through a 5 to 8 percent assessment for each hire (Hoffman 2003).

For several years in the mid-2000s, Shell faced problems with identifying the status of its oil reserves. In 2004, the company downgraded the book value of its reserves by 20 percent, leading to a major restructuring and the departure of top executives. After being sued by investors complaining about misleading information, Shell settled for $350 million (Hanney 2007).

Outsourcing and Standards

Since Shell is a smaller player in the market, it has found it necessary to partner with other companies to reduce costs and expand its capabilities. In particular, the company partnered with Chevron and Schlumberger Ltd. to define a vendor-neutral suite of applications for petroleum companies. Known as OpenSpirit, the technology should make it possible to integrate applications from multiple vendors into one framework (Ohlson 2000).

The OpenSpirit system is specifically designed to transform data from a variety of common sources, including seismic systems. It can scan databases, handle 2-D and 3-D projects, and maintain everything in a GIS database. The system supports multiple languages and platforms, including Java and C++ on Windows, Solaris (Sun), and Linux. It also contains connectors to ArcView (for GIS) and Excel (www.openspirit.com).

Shell has also turned to outside vendors to provide additional expertise in integrating data. In 2001, the company chose IBM to configure and set up three new data centers located in Houston, The Hague (headquarters), and Kuala Lumpur. Shell's general manager for IT projects, Alan Matula, said that "we were looking for a trusted technology partner to help us achieve aggressive TCO [total cost of ownership] targets in our MegaCentre project. It is one of the most important IT initiatives in Shell's history" (Vijayan 2001). Shell also worked with IBM to develop a high-performance Linux-based cluster to analyze seismic data. In 2004, Shell went even further and negotiated an agreement to outsource most IT functions to India-based Wipro and IBM. The company is trying to reduce its 9,000-employee IT workforce by 30 percent by 2006 in an effort to cut about $850 million a year (McDougall 2004).

Shell also realized that its communication network was "fragmented across business units," according to Rob van Zwieteren, the telecommunications manager. The goal is to save $50 million over three years by consolidating all communications into a single network infrastructure. The master contract is handled by Cable & Wireless (Cope 2001).

In early 2008, Shell signed a $4 billion outsourcing contract with AT&T, EDS, and T-Systems. In the initial five-year deal, almost 3,000 IT workers were transferred to the service providers. Each of the three partners would specialize, so minimal overlap existed. AT&T handled networking and telecommunications, T-Systems controlled hosting and storage, and EDS was responsible for end-user computing and integration of the infrastructure (Chapman 2008). The IT organization of 8,000 employees and contractors handles IT tasks for 150,000 users worldwide.

Unfortunately, contract employees can be more difficult to control than traditional full-time employees. In October 2008, Shell learned that someone had used Shell employment data to file fake unemployment claims. Without naming the worker, officials noticed that had pulled records from the master employment database and used the data to file false claims to obtain unemployment insurance benefits (McMillan 2008).

Knowledge Management

Solving problems in a huge company with experts scattered around the globe can be a challenge. Shell's Arjan van Unnik notes that "what we had was a community of expatriates who might link up when they encountered a problem. We had knowledge management, but not that much" (King 2001). To improve communication and sharing, Shell implemented a $1.5 million project using off-the-shelf collaboration software in 1999. The system evolved into 13 Web-based communities used by more than 10,000 employees. By sharing technical data and providing the opportunity for employees to ask questions, the system is estimated to have provided $200 million in benefits in less than two years (King 2001).

One challenge with KM projects is that the name has garnered a negative reputation. Several large projects were created that tried to capture wide levels of knowledge across an entire organization. Projects that large and broad tended to fail, giving KM a bad name. Yet the concept of KM is still important—particularly in a geographically diverse company, and in an industry facing retiring experts. Consequently, the KM label was discarded on the Shell project, and it was renamed "new ways of working." The group found that the system actually had to direct user discussions. It was not enough to just store and retrieve knowledge. People need more guidance. In particular, when the system splintered into more than 100 communities, the IT group had to redefine the groups and educate people to reduce the number of communities down to 12 specific communities (Kontzer 2003).

Questions

1. What problems has Royal Dutch experienced because of decentralization?
2. How is Royal Dutch using information technology to improve communications in its decentralized environment?
3. How is Royal Dutch's focus on reducing IT costs and centralizing services at three data centers going to solve its problems?

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Case: ChevronTexaco

Chevron merged with Texaco at the end of 2001. The new firm (ticker: CVX) had sales of over $120 billion in 2003 with over 60,000 employees. It is headquartered in San Francisco. The merger created some issues with the ongoing Internet explorations by both companies. But, the dot-com crash at about the same time made those issues irrelevant (King 2000).

One of the more interesting aspects of the merger was the consolidation of their telecommunication networks. Because both companies had operations around the world, they had both contracted with AT&T to provide international telecommunication services. The merger provided the opportunity to consolidate the networks to reduce costs. In terms of financial systems, Chevron was using SAP software, while Texaco had an older custom system built over the years. Texaco replaced the system with SAP prior to the merger. (Collett 1999).

Partly because of the merger, partly because of the expanded use of the Internet, from 1999 to 2001, Chevron's Internet demands increased by 200 percent a year for those three years. The company upgraded routers and servers to handle the new demands (Maselli 2001).

Managing desktops in a company scattered around the world is difficult. Dave Clementz, the CIO, standardized the company on a common network backbone. He also rolled out Windows XP early in 2002 to ensure that everyone had the same platform. For some cases, he installed thin-client terminals. The applications for the thin clients are stored on a central server, making it easier to update and troubleshoot the applications. The company is also planning to move to Web-based applications. Employees who need only simple tools, like e-mail, could run everything through a thin-client browser (Maselli 2001). IT directors at both companies were leaning to Web-based applications to provide more centralized management and reduced cost of applications.

In 2003, the combined ChevronTexaco signed an agreement to work with IBM and BearingPoint for supply chain management, procurement, and outsourcing. IBM was a lead contractor on merging the SAP systems of the two companies. IBM was also negotiating to provide outsource facilities and hosted services (McDougall 2003). ChevronTexaco CEO David O'Reilly in 2003 that combining IT operations from the two companies has saved the company $2.2 billion—twice the amount originally projected. When the two companies began the merger, they realized early on that they needed outside help (Evans 2003).

Big companies with multiple locations also generate issues with security. It is difficult enough to track IT assets. (Who is currently assigned to which computer?) It is also difficult to control user access to systems and applications. Chevron purchased eProvision Day One software from Business Layers to manage these processes. The system uses Lightweight Directory Access Protocol (LDAP) to track the user groups. It stores account data and access rights for voice mail, e-mail, and even cell phones. The system consolidates data from dozens of older databases used throughout the company—often including Excel spreadsheets. Centralizing the account data makes it easier to see and control user access rights. It also makes it easy to remove all permissions when an employee leaves the company (Verton 2001).

Chevron uses a high-technology Cooperation Center at its San Ardo, CA oil field to help managers visualize construction, maintenance, and drilling operations. Jim Crompton, IT adviser for Chevron's operations observed that "people come out of their functional view and begin to see the same picture. The work they do is so interdependent. If you drill a new well and it produces 100 barrels of oil, you have to have the pipeline, you have to have the processing capability, you have to have everything that's downstream of that well or you end up having to suspend operations in one place until it all works together" (Chabrow 2006).

In total, Chevron Corp. adds 2 terabytes of data a day to its systems, but Gary Masada, corporate CIO sees the data as an opportunity, noting "it's an issue of, you have this information; how are you going to search it and use it?" In many cases, Mr. Masada prefers large projects because they are better integrated—leading to greater benefits. For instance, the Global Information Link connects 50,000 desktops at 1,800 locations and was projected to save the company $50 million a year (Anthes 2006).

In 2008, Louie Ehrlich was appointed CIO of Chevron. In an interview, he talks about how he handled the transition. His first action was to go around and talk with the 60 leading executives at the company and ask them three basic questions: "What was important to you in your business, what's working well with IT at Chevron and what's not?" Later, he held lunch meetings with typical employees and asked them similar questions (Mitchell 2009). He noted that the high number of mergers had created duplication and an complex IT environment. One of his primary goals was to simplify, reduce the number of vendors and reduce the number of applications.

In 2011, Chevron was interested in mobile computing and tested using tablets such as the Apple iPad. Peter Breunig, general manager of technology management and architecture noted that "In 1990, it was the PC desktop with Excel. Now you can give them mobile platforms that are more powerful and more compact. That's like having calculators on steroids, with tie-ins back to corporate data stores. That's an opportunity, in my mind" (Hamblen 2011).

Questions

1. What benefits does ChevronTexaco gain with thin-client and Web-based applications?
2. Why is ChevronTexaco using LDAP to consolidate its user accounts instead of standardizing the underlying systems?
3. What did ChevronTexaco gain by consolidating its international telecommunication systems? Were there any other options?

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Case: Exploration

NuTec Energy Services is a specialty company that provides data and data visualization services for oil exploration. In particular, the Houston-based company takes raw seismic data and converts it into 3-D images. The company focuses on the Outer Continental Shelf (OCS) in the Gulf of Mexico. Customers purchase data by the OCS block which is one square kilometer. The analyses use from 2 to 20 terabytes of data per project. Although profitable, the company was being squeezed between customers who wanted lower prices and increased computational and storage costs. NuTec solved its cost problems by moving to Linux-based servers and installing a dual-controller storage area network (SAN). The open-source system reduced costs by 84 percent. The challenge is that the servers have to deliver the massive data quickly to the 220 or more servers performing the computations. The system requires a high-speed network to move the data off the storage devices to the requesting computers. To solve the problem, NuTec installed two subsystems. One system serves the highly nonlinear analysis computers that perform intensive computations but pull data in bulk. Data for that system is stored on an EMC Clariion FC4700 linked to four servers running GFS. It feeds 130 Linux computational servers. The second analytical system performs a simpler calculation, but draws huge amounts of data quickly. Data for that time imaging system is stored on a MetaStor E4600 array from LSI, routed through McData 6140 SAN switches to 220 computational servers (Scheier 2004).

Anadarko Petroleum in Woodlands, Texas, faced similar problems with data storage. The company needed to consolidate the seismic 2-D and 3-D data used by its engineers, geologist, and geophysicists. The company installed network-attached storage (NAS) devices from Network Appliance. The new system uses EMC Symmetrix boxes to hold 110 terabytes of data. The conversion took 20 months. But CIO Morris Helbach notes that "an exploration and production company lives and dies by the way it acquires, manages and provides access to data" (Songini 2003). In 2006, Anadarko expanded its market position by acquiring two large competitors, Kerr-McGee and Western Gas Resources, making Anadarko the largest independent oil and gas producer in the United States (Weekly Corporate Growth Report 2006).

British Petroleum (BP) faced a slightly different problem with similar data. The third-largest oil company has hundreds of leases in the Gulf of Mexico. But it does not have the staff to analyze all of the data. Steve Decatur, staff development deployment leader in the Houston office, observed that "it would take us four years with our current manpower to get all these properties analyzed" (Bryce 2001). The company found an innovative solution. It created a Web site and invited freelancers to analyze the data. Freelance analysts who develop suitable drilling plans get $50,000. If the wells produce oil, they receive a cash bonus. If BP does not drill, the analysts can take the plans to another company. The company initially provided data on five Gulf tracts. Based on the quality of responses, it eventually added 18 more to the site (Bryce 2001).

Having the information is only the first step. Employees also need to be able to find the information needed when they have a question. Knowledge Management tools can help provide access to data. Intec is a Houston-based engineering firm that provides support and project management to the oil industry around the globe. Beginning as a small firm, the engineers were collaborative and shared information on 3x5 file cards. By 2002, the company was too big to use paper-based information. A team purchased KM software from AskMe and built a library-based system to store the company's knowledge and engineering expertise. Now, engineers can go online, ask a question, and get results and sample documents from the library in minutes (Melymuka, 2003).

Oil fields are often in remote locations—and exploratory drilling operations tend to be even farther away from civilization. Yet communicating among the workers on site and with managers and coworkers around the world is still important. A startup company (Texas Energy Network) built a network that runs on the long-term evolution (LTE) phone system to provide high-speed access in out-of-the-way places. Instead of trying to run cables and fiber optic lines, the LTE system uses wireless modems. The company hopes to cover several miles with a centralized tower (Lawson 2010).

Questions

1. What are the benefits to outsourcing analysis of oil field data? What are the drawbacks?
2. What information technologies are important in the oil exploration industry?

Additional Reading

Bryce, Robert, "BP Drills Web," *eWeek*, July 9, 2001.

Lawson, Stephen, "LTE Demo Will Test Broadband for Oil Fields," *Computerworld*, August 20, 2010.

Melymuka, Kathleen, "Knowledge Management Helps Intec be Smarter by the Hour," *Computerworld*, June 23, 2003.

Scheier, Robert L., "Seismic Data Firm Boosts Throughput, Cuts Costs With Super-Scalable SAN," *Computerworld*, January 6, 2004.

Songini, Marc L., "Profile: Joan Dunn," *Computerworld*, January 6, 2003.

Weekly Corporate Growth Report, "Anadarko Petroleum to Purchase Kerr-McGee Corporation for 2.77 Times Revenue," July 3, 2006.

Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Chapter 14

Information Management and Society

Chapter Outline

What You Will Learn in This Chapter

- How does your company affect the rest of the world? What influence does the outside world have on your company?
- How does information technology affect individuals? As a manager and a company, do you treat individuals the way you expect to be treated by other companies?
- How does technology affect jobs? If computers do more of the work, what jobs are left for people?
- How does technology change the relationship between businesses and consumers?
- Can information technology change education?
- How does technology affect different areas of society?
- Can information technology improve governments?
- Do criminals know how to use computers?
- How do your actions affect society? Is it possible to follow the laws and still be wrong?
- What major laws affect technology and the use of computers?
- What risks are created through using cloud computing?

Sutter Health

How do information systems affect society? From one perspective, health care organizations are simply another business. Yet, because of their costs, importance to our daily lives, and widespread governmental involvement, health care has a special role in society. Not surprisingly, most physicians and other health care workers receive minimal training in information systems and are not comfortable with it. Consequently, information systems for medical care are being introduced slowly. On the other hand, information systems have the ability to reduce errors as well as costs. In particular, health care organizations like Sutter Health are working to implement electronic drug ordering and dispensing systems. Sutter is also working to implement paperless medical offices and already has 400 member physicians using a completely electronic system—including X-rays and prescriptions. The group is also working with telemedicine—particularly with intensive care units (ICUs) to reduce the costs of physicians and provide better care to remote locations. Of course, security and privacy issues become major areas of concern with medical information systems.

Introduction

How does your company affect the rest of the world? What influence does the outside world have on your company? Why should you care? Try an easier question: How much do your customers care about privacy? When you use information technology to help your company, it means you are collecting and analyzing data on customers and employees. As shown in Figure 14.1, your company lives within an environment. Companies influence the world through relationships with customers, employees, and other companies. In turn, your organization is affected by events in the world ranging from government laws to education and public opinion. When you make business decisions, you need to think about these interaction effects. Even if you cannot change the world yourself, you should be aware of the effects of your choices so that you are ready to deal with the consequences.

If nothing else, history has shown that technological change is inevitable. Competitive economics virtually guarantees that the search for new products, new manufacturing techniques, and other ways to gain competitive advantage will continue. Changes in technology often affect society. Technology can change individuals, jobs, education, governments, and social interactions. As components of society, each group has rights and responsibilities to others, such as a right to privacy and obligations regarding ethics.

Technology effects on individuals can be beneficial or detrimental. Often a change in technology helps one set of individuals and harms another group. Typical problems include loss of privacy, depersonalization, and changing incentives or motivations. Advantages include lower prices and better products and service. The effect on jobs is hard to predict, but most observers conclude that workers will require more education and training. Most authorities think that increases in technology in the past generally led to an increase in the number of jobs. Now, however, many of the new jobs require higher levels of education, and the workers displaced by technology rarely have the qualifications needed for the new jobs.

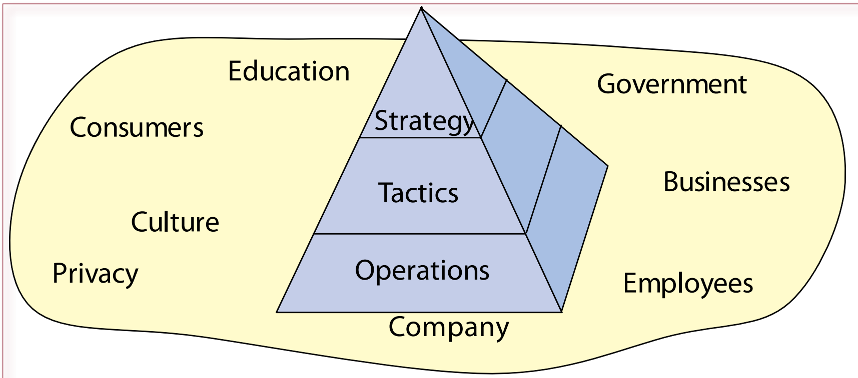


Figure 14.1

Information management and society. Every organization and individual exist in a social environment. Changes in the firm and changes in technology affect the environment. Changes in the environment can affect the firm. An understanding of these interactions will make you a better manager.

Technology also has an effect on crime. Technology creates new crimes, new ways to commit crimes, and new ways to catch criminals.

In addition to the increased demand, technology has provided new teaching methods. Although there is considerable debate over the costs and benefits of technology in education, there is usually a place for technology, even if only as a specialized technique. However, most educators know that technology cannot succeed by itself. Technology can isolate or it can build connections, but it requires people and applications to improve learning.

Governments attempt to control these impacts of technology by creating laws, but laws often bring their own problems. Also, in times of rapid change, laws rarely keep up with the changes in technology. Governments are also directly affected by improved communication facilities. For example, technology makes it possible for governments to better understand the needs of the citizens and provide more avenues for communication.

Technology can alter any number of social interactions. Social groups can gain or lose power, and types or methods of criminals are altered. Furthermore, society can become dependent on technology, which is not necessarily bad, but it causes problems if the technology is removed or substantially altered.

Individuals

How does information technology affect individuals? As a manager and a company, do you treat individuals the way you expect to be treated by other companies? Information technology plays an important role in the lives of most individuals. Many jobs are directly involved in the collection, processing, and evaluation of data. Performance of many workers is continually monitored by computers. As consumers, virtually our entire lives are recorded and analyzed. Governments maintain massive files on all public aspects of our lives. Increasingly, these public files are accessible to anyone via the Web and a few dollars. **Privacy** is a delicate and controversial issue. Citizens must work together to live in a society, which requires giving up some elements of pri-

Trends

The industrial revolution in the late 18th century caused many changes to society. Before the revolution, workers were predominantly employed as craftsmen, farmers, or lesser-skilled laborers. Mechanization brought standardization and assembly lines, for which jobs were reduced to simple, repetitive tasks.

As transportation improved, people moved from farms to cities, and cities spread to suburbs. Communication systems improved and linked the populations back together. Better product distribution mechanisms changed the way products are sold. Companies (such as Sears, through its catalogs) began to distribute products nationally instead of relying on small local stores. National and international markets developed with every change in the communication and transportation systems.

These changes were so strong that philosophers and writers began to take note of how technological changes can affect society. From the bleak pictures painted by Dickens, Marx, and Orwell, to the fantastic voyages of Verne, Heinlein, and Asimov, we can read thousands of opinions and predictions about how technology might affect the political, economic, and social environments.

vacy. Businesses and governments often need to identify customers and employees to perform basic functions. Yet history reveals that individuals can be threatened or coerced if some people or organizations collect too much information.

Although data has been collected on citizens for many years, recent improvements in technology raise greater concerns about privacy. As computer capabilities increase, it becomes possible to collect, integrate, and analyze the huge volume of data. Using publicly available data, it is possible to collect an amazing amount of data on any person.

Privacy

As Figure 14.2 indicates, companies, governments, and employers collect data about many aspects of our lives. Most of the modern marketing efforts including data mining and building customer relationships require information about customers. Marketing and sales can be improved by maintaining databases of consumer information and tracking sales and preferences at the customer level. Combining government statistics and data from market research firms with geographical data can provide a precise picture of consumer demands. It also might represent an invasion of privacy for individuals. With databases available even to small companies, it is easy to acquire basic data on any individual. For instance, phone numbers and addresses are readily available online. Data collected by governmental agencies such as voter registration and property records can be purchased from several online sources. More comprehensive commercial databases are available from specialty marketing companies. Few laws exist that limit the use of personal data.

It is easy to obtain lists from universities, clubs and social organizations, magazine subscriptions, and mail-order firms. Statistical data can be purchased from the U.S. government. Although most U.S. agencies are forbidden to release specific individual observations until 50 years after the collection date, statistical av-

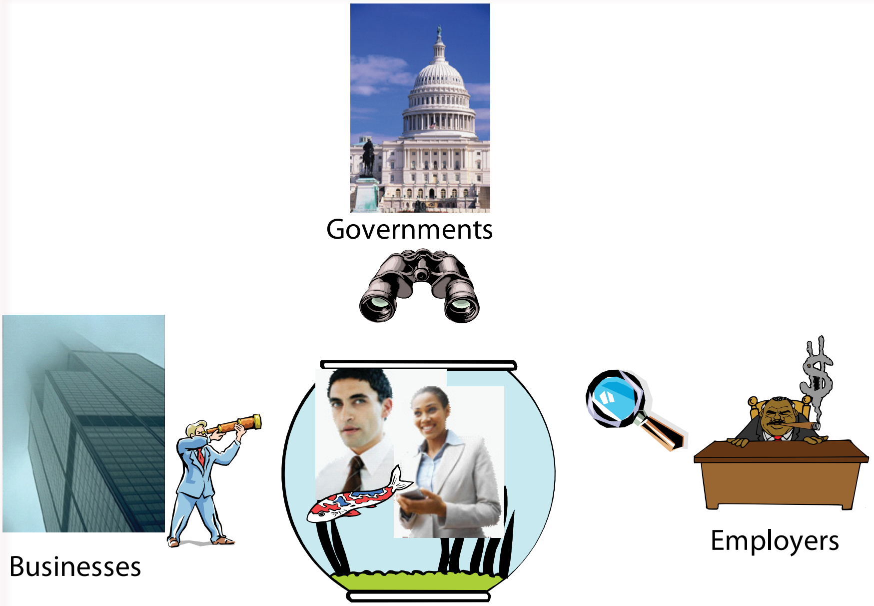


Figure 14.2

Privacy. Businesses, employers, and governments all have reasons to collect data on individuals. The challenge lies in balancing these needs with the privacy of the individuals. Historically, there have been many instances of abuse and fraud when this balance is not achieved.

erages can be highly accurate. By combining the statistical averages with your address, your actual income might be estimated to within a few thousand dollars.

Because most people prefer to maintain their privacy, companies have an ethical (and sometimes legal) obligation to respect their wishes. Individuals can always ask companies not to distribute personal data. Companies should give consumers the option of protecting personal data by building the option into their databases and informing consumers whenever companies collect data.

Consumer Privacy

As shown in Figure 14.3, a tremendous amount of data is collected on consumers. In the early years, consumer activists primarily worried about government data collection. Governments had computers and the authority to force citizens to provide data. Today, businesses can easily collect, obtain, and integrate almost the same level of data available to government agencies. In fact, government agencies have begun using commercial databases in some cases. Credit card and credit bureau data are the two most detailed sources of consumer data.

Consumers have little control over the collection of personal data. But it is interesting how cheaply people will give up their privacy. Grocery store loyalty cards collect a tremendous amount of personal purchase data. Customers routinely sign up for the cards in exchange for a tiny discount on prices. The purchase data is sold to marketing companies and manufacturers to track sales and the success of marketing campaigns.

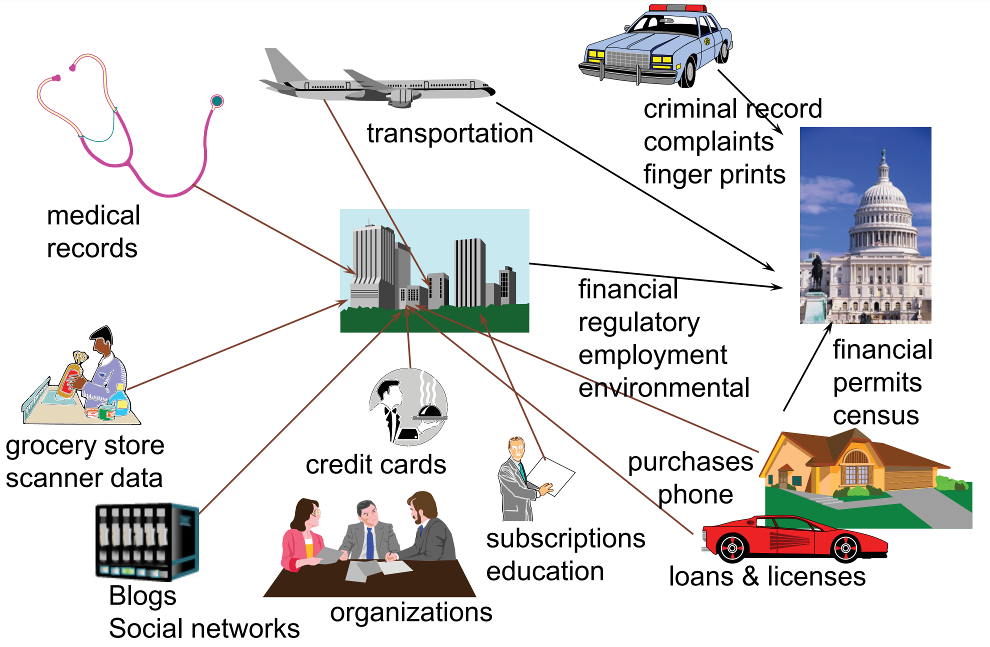


Figure 14.3

Privacy. Many businesses and government agencies collect data. With increasing computer capabilities, it is becoming possible to collect and correlate this data to track many aspects of individual lives.

A significant question remains as to whether consumers really care about their privacy. The loyalty card data and lack of concern over financial records indicate that many people do not care about privacy. Yet over 50 percent of U.S. households signed up for the national do-not-call list to stop telemarketing calls. Perhaps the conclusion is that customers do not mind having data collected, but they do not like being solicited directly.

On the other hand, at times, consumers seem more concerned about online data collection. The technology for Web sites did not initially consider the demands of e-commerce. It was originally intended to simply display pages independently—every request for a page is independent of any other request. For e-commerce, the Web server needs to track information about the person requesting a page. For instance, a shopping cart system needs to store items selected by the customer. Similarly, any site using security needs to track the user through a series of pages—otherwise it would force the user to log in for every new page. These problems were solved with the creation of "magic" **cookies**. A Web cookie is a small text file that the server asks the browser to store on the user's computer. As shown in Figure 14.4, whenever the browser requests another page from that server, it returns the cookie file containing an identification number. Hence, the server knows which user is returning. This use of cookies is common and relatively benign. Yes, the cookie could be used to track visitors, but presumably the visitor is purchasing items and already willingly provides detailed information to complete the transaction.

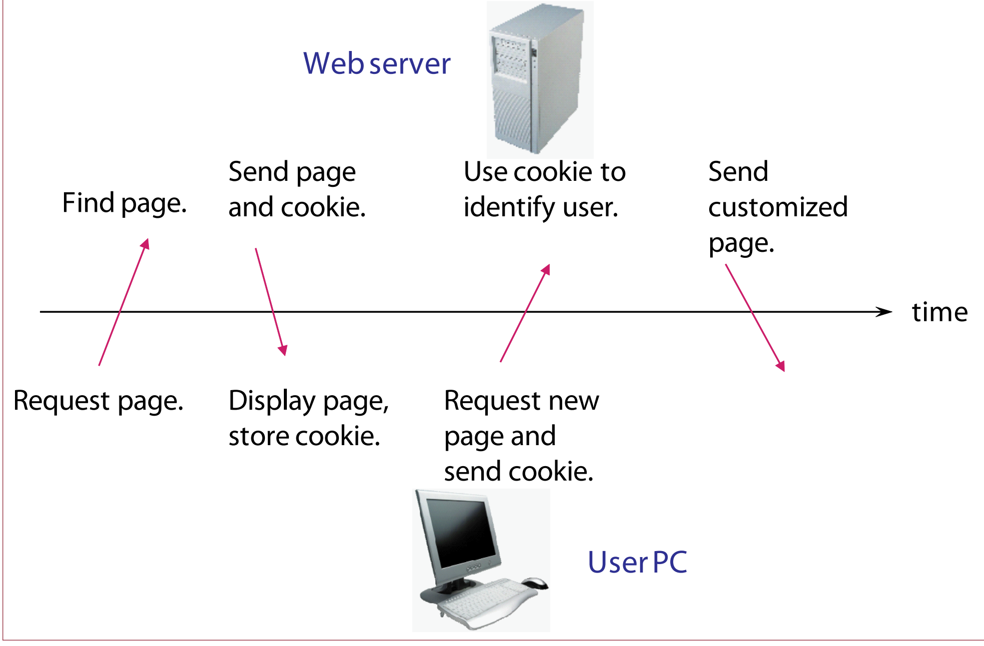
Reality Bytes: Medical Privacy

In early 2011, U.S. Representative Gabrielle Giffords and several others were shot in one of the worst public shooting sprees in the United States. Less than a week later, three employees of the Tucson University Medical Center were fired for accessing the medical records of some of the victims without permission. A nurse working under contract was also fired. The UMC noted that it had installed technology to track unwarranted data access and the three were fired "in accordance with UMC's zero-tolerance policy on patient privacy violations." Although most medical workers are careful about patient privacy, this example is not an isolated incident. In April 2009, a Kaiser Permanent hospital near Los Angeles fired 15 workers for accessing medical records of a patient. In 2008, the University of California revealed that over 13 years, as many as 165 medical personnel, including physicians, had improperly accessed records about celebrities.

Adapted from Jaikumar Vijayan, "Three Fired for Accessing Records of Tucson Shooting Victims," *Computerworld*, January 13, 2011.

Figure 14.4

Web cookies. Cookies are used to keep track of the user across page requests. Each time the user PC requests a page, it returns a small text file (cookie) containing an identification number.



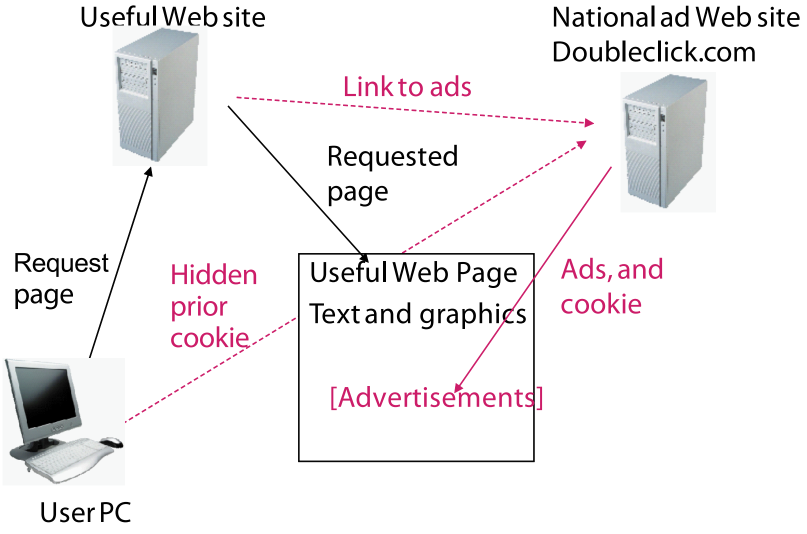


Figure 14.5

Misuse of Web cookies. Doubleclick.com as a third party places cookies onto visitor PCs. Every time the visitor sees an ad delivered by Doubleclick, Doubleclick records the user, the date/time, and the site visited. Doubleclick attempted to market this huge database.

Figure 14.5 shows a more troublesome use of cookies. In 2000, it was revealed that Doubleclick.com (now owned by Google), the leading Web advertisement-placing firm was using cookies as a third party to track page visits by millions of people. Leading Web sites register with Doubleclick to carry advertising. Companies wishing to advertise on the Web create the ad and pay Doubleclick to carry it on its servers. The original Web site includes a link to Doubleclick software that delivers the ads and records page views so that the site owners can be paid the correct fee. However, Doubleclick also includes a cookie that is sent to the visiting PC with each ad placement. Anytime the user visits a site that deals with Doubleclick, the identifying cookie, date/time, and site visited are stored on Doubleclick's servers. Web users were understandably upset when Doubleclick attempted to market this data collection—particularly when the company wanted to tie the online identities to real-world names and addresses. In effect, third-party cookies enable the company to provide information on every site visited by users. In the fall of 2010, the *Wall Street Journal* ran a series of article examining Web sites, cookies, and other tracking devices. Researchers found hundreds of sites tracking users—many of them placing multiple tracking items on user computers.

To prevent this loss of privacy, browsers enable you to turn off cookies—but then you will not be able to use many secure sites, such as those run by banks. Today's browsers offer more control over cookies—in particular, you can refuse to accept third-party cookies such as those placed by Doubleclick. Finding the option is not always easy, but it is one important step to protect your privacy. In 2011, Microsoft and other browser vendors began implementing new ideas for specifying privacy levels in the browser. The main problem is that no Web sites or companies are configured to handle the new methods. And the new methods are not standardized, so it will likely take time before usable privacy controls arrive.

Reality Bytes: Google v. Spain

International laws on privacy are often stronger than those in the United States. For example, the Spanish government has an Agency of Data Protection. The existence of the agency alone is important—it handles citizen complaints about the way their personal data is handled on the Internet. And, the agency has taken a relatively strong position with Google and its search system. The agency claims that Google must delete links to any Web sites that contain information that might compromise an individual's right to privacy. For example, whenever citizens find embarrassing information about themselves on the Web, they can petition to have Google remove any links to that data. In a legal case before the Spanish courts, Google argues that the privacy agency does not force news agencies to remove any of the content. Other countries target the original news source rather than the search engines.

Adapted From David Roman, "Google Contests Spain's Privacy Laws," *The Wall Street Journal*, January 17, 2011.

Wireless technologies offer even more methods for tracking people. Did you know that over 50 percent of emergency calls are made on cell phones? The federal e-911 law requires cell phone operators to provide location data on cell phones. Manufacturers have embedded GPS locator chips within cell phones. Triangulation and signal strength are also used as backup methods. While this data is useful for emergencies, it could also be used for commercial purposes. The company and Web site Loopt has a system where you and your friends can sign up, so that you can open a map to see where your friends are located. This site is used by other applications to enable tracking of your friends. Other sites such as foursquare encourage people to "check-in" to stores to indicate their location to friends, and the rest of the world.

In the realm of autos, GM's On-Star system has been around for years and it tracks the location of your car at all times—for a monthly fee. In 2011, insurance companies in some states began offering discounts to customers who install driving monitors in their cars—not only tracking location but also how you drive. As an individual, do you care if you are tracked? Keep in mind that any stored data can be retrieved by the police or by lawyers in a court case. This data has played a role for both prosecution and defense attorneys in some high-profile cases. But, if you are a completely honest person, perhaps the tracking systems could be good—they might be useful for proving your innocence if you are falsely accused of something—by the police or by your girlfriend/boyfriend.

Imagine the commercial opportunities of broadcasting messages to consumer cell phones as they walk by your store. Now, ask yourself whether you want to be continually interrupted as you walk through the mall, and whether you want stores to be able to track that you walked by the store. On the other hand, the same technology could be used to broadcast emergency messages to any cell phone within a danger zone (fire, tsunami, terrorist attack, and so on).

Employee Privacy

Computers have created other problems with respect to individual privacy. They are sometimes used to monitor employees. Computers can automatically track all of the work done by each person. Some employers post this data on public bul-

Reality Bytes: Hard to Claim Benevolence When You Take Away The Internet

In the "Arab Spring" of 2011, unrest in North African nations led to political changes in many countries. Tunisia was one of the first nations to remove its longtime leader. Egyptian citizens quickly began to follow—with protests and talk of overthrowing long-time leader Mubarek. Mubarek, and many other leaders, believed that the Internet and cell phones were providing communication tools to dissidents. So, by January 28, 2011, the Egyptian government shut down virtually all networks in Egypt. James Cowie, CTO at Internet monitoring firm Renesys noted that "This is on a differnet level entirely. There's no cutting off the finger to save the patient here. This really is the Armageddon approach." In a developed nation like Egypt, the Internet is not just a tool for the wealthy—it has become part of the way business is conducted. And, Internet connections are relatively robust. About the only way to shut down everything was for an official to call all of the ISPs and demand they cease operations. But, shutting down the entire local Internet affects the entire country. That message alone would likely encourage the rest of the population to question the control and intentions of the leaders. A few days later, Mubarek resigned. Internet access and cell phone networks were eventually restored. Iran is another nation that is going even further to control the Internet. The leaders a building a new "national Internet" that would be completely under the control of the government. Reza Begheri Asl, director of the Iranian telecommunication ministry's research institute said that almost 60 percent of the homes and businesses are on the new network and within two years it would cover the entire country. Some reports say the regime plans to roll out a new operating system to replace Microsoft Windows. Abdolmajid Riazi, when he was deputy director of communication technology in the ministry of telecommunicaitons, said that "It will instead empower Iran and protect its society from cultural invasion and threats. Top officials have said that they consider Western culture and ideas to be a major threat. Cuba currently runs a dual-Internet system, one for the government (and tourists) and a local public one with limited access. The U.S. State Department funds the development of tools to help bypass Internet censorship.

Adapted from Jaikumar Vijayan, "Egypt's 'Net Blockage an 'Armageddon Approach'," *Computerworld*, January 28, 2011; and Christopher Rhoads and Farnaz Fassihi, "Iran Vows to Unplug Internet," *The Wall Street Journal*, May 28, 2011.

letin boards to encourage employees to work harder. Some software available for local area networks enables managers to see exactly what every employee is doing—without the employees knowing they are being watched. Some employers read their employees' electronic-mail messages. Currently, all of these activities are legal in the United States.

Many companies use electronic badges, which employees use to unlock doors. The systems are run by a centralized computer that can be programmed to allow access to specific people only during certain hours. These systems enable employers to track the daily movements of all employees—including the amount of time spent in the restroom.

Courts have repeatedly held that property owned by the employer is completely within its control. Hence, employers have the right to impose any controls or monitoring they wish; as long as they do not violate other laws, such as the discrimination laws.

Reality Bytes: Should Public Data be Private?

Many people are unaware of the amount of public data collected—or aware that it is public. Basic items such as birth, death, and marriage records are recorded publicly—typically at county offices. This data was originally considered to be public so that people could verify the identity of others. In essence, you register with the local government, and it vouches for your identity. Property and some debt records are recorded publicly so that ownership can be verified. Criminal data is public so citizens can recognize lawbreakers. Originally, the files were on paper, and local newspapers would report on the items of interest to the local citizens. Then companies started retrieving the data and putting it online. Leading to cases where a person with a speeding ticket can Google his or her name and see not only the ticket and fine but personal information such as driver's license number and date of birth. The rules about what can be done with public data vary by state.

Adapted from Elizabeth Garone, "Help, Google Knows About My Speeding Ticket," *The Wall Street Journal*, February 3, 2011.

It is easy to question why employers might feel the need to monitor their employees. At some point, you have to trust your employees to do their jobs. If an employee has so little work to do that he or she can "waste time using the Internet for personal use," the bigger problem is money the company is wasting on an unneeded employee. On the other hand, most major financial losses come from insiders such as employees and consultants. Furthermore, many companies have been burned by criminals when the companies were not careful enough in hiring and monitoring. Other industries have specific requirements that almost mandate they monitor employees. For instance, the brokerage industry has many regulations dealing with customer contacts, so it routinely monitors employee e-mail messages and phone calls to ensure rules are followed.

Government Privacy

Privacy from government agencies and their employees can be a touchy issue. As citizens, we agree to cooperate with government agencies to improve all of our lives. And to function properly, government agencies can require detailed personal data. For example, as shown in Figure 14.6, most governments collect health data, police records, driving records, international travel, and detailed financial data for taxes. Recipients of federal programs, such as farm subsidies, must report business data. Many people are also required to complete census surveys collecting detailed information about their lives. In the United States, much of this data is protected and can be shared or released only under specific conditions. But there have been several cases of government employees illegally browsing through records for their neighbors or even selling data. In 1991, 18 people were accused of selling Social Security information, including six government employees (*Government Computer News*, January 6, 1992, p. 58).

In the United States, few laws or regulations control the use of data held by private organizations. However, several federal laws control the use of data collected by government agencies. For example, federal agencies are restricted from sharing databases except in specific situations. In most cases the FBI cannot access the IRS data without special permits. In terms of collection and use of data by private

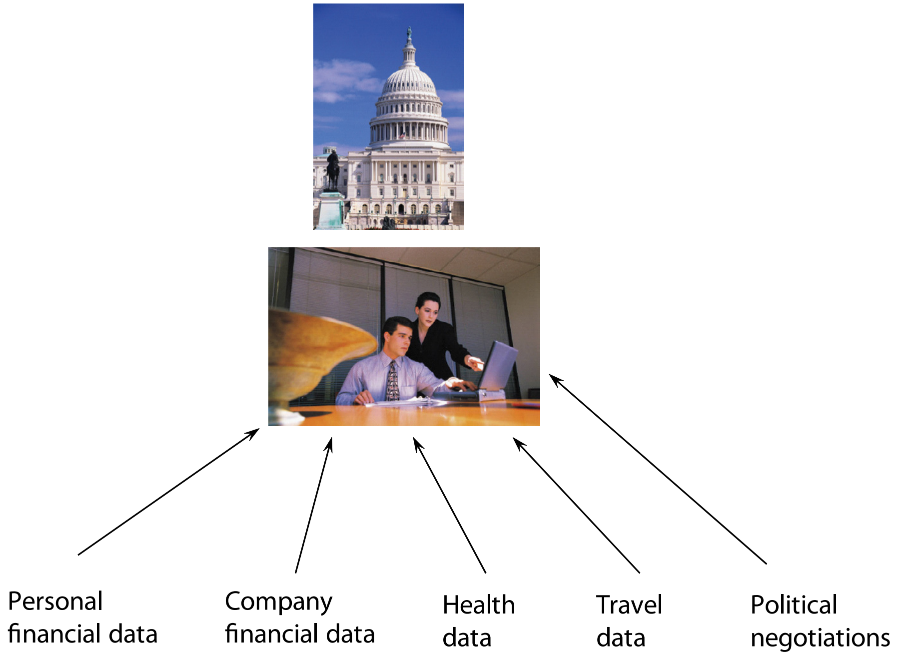


Figure 14.6

Government and privacy. Spying on "ordinary" people is not an issue. Spying on business and political leaders or journalists can cause problems. Collecting data on targeted individuals such as dissidents or minorities can stifle innovation.

companies, few restrictions exist. Contrary to popular belief, there is no "right to privacy" specified in federal law. However, an element of privacy is contained in a few scattered federal laws and some state laws, and in some Supreme Court interpretations. For example, one federal law prohibits movie rental stores (and libraries) from disclosing lists of items rented by individuals. But this law was largely voided by the Patriot Act of 2001.

As everyone was reminded on September 11, 2001, the flip side to privacy is the need for governments to identify and track individuals to prevent crimes and terrorism. As an open society, the United States has chosen to lean toward individual rights and privacy; but many people have suggested that more control and less privacy would make it easier to stop potential terrorists and criminals. Because of the capabilities of modern information systems and networks, it is now possible to build powerful systems that identify and track individuals within the nation and around the world. Some people have suggested that the United States should establish national identity cards, as used in many European nations. A single, unified database would make it easier to track individual actions.

People tend to be split on the issues of government privacy. Some hate the fact that they have to provide data. Others wonder what the problem is: if you tell your friends how much money you make, why not tell the government? In one sense, public information keeps everyone honest. And for many people, it probably does not matter if various government agencies collect personal data. No one really cares about the personal details of the housewife in Peoria. On the other hand,

Reality Bytes: Google Tracks Police Requests

As a leading portal to the Internet, Google is used by everyone. And, in a twist on the old adage "You are what you eat," the digital version has become: "You are what you Google." If someone looked at all of your searches, they could identify what you are working on, planning, or perhaps even thinking. So, the police are increasingly getting Court warrants to obtain Google search data. Agents from other countries place additional requests on Google. In 2010, Google set up an online site to display the frequency of these requests so citizens could see the increasing importance. In the first half of 2010 alone, Google counted more than 4,200 requests in the United States (the country with the largest number of requests). As mobile computing becomes mainstream, police also turn to the cell-phone providers, not just to obtain calling data, but also e-mail and text messages. In 2007, Verizon reported to Congress that it receives 90,000 requests a year. In 2009, Facebook told Newsweek that it received 10 to 20 subpoenas and court orders a day. The U.S. Justice Department has argued in a Colorado Court that it should be able to access e-mails without a search warrant. Does it matter? Ryan Calo, director of the consumer privacy project at the Center for Internet & Society at Stanford Law School notes that "When your job is to protect us by fighting and prosecuting crime, you want every tool available. No one thinks D.O.J. and other investigative agencies are sitting there twisting their mustache trying to violate civil liberties. They're trying to do their job."

Adapted from Miguel Helft and Claire Cain Miller, "1986 Privacy Law is Outrun by the Web," *The New York Times*, January 9, 2011.

some people within governments have abused their positions in the past. Consider the tales of J. Edgar Hoover, longtime head of the FBI. He was obsessed with collecting data on people and built files on tens of thousands of people. Ostensibly he was attempting to remove "subversives" and was a leading cause of the McCarthy anticommunism hearings in the 1950s. He also collected thousands of secret files on politicians, journalists, and business leaders. He used these files to harass and blackmail leaders. Even if a modern-day data collector is not as blatant as Hoover, and even if modern politicians have fewer moral problems, there is still an important risk. What if a politician tries to spy on or interfere with political negotiations? CIA records released in 2007 also reveal the extent of then-president Johnson's use of the CIA to illegally spy on U.S. citizens in the 1960s and 1970s. He used the "communist threat" to justify spying on college students, journalists, and others participating in the anti-war movement. The same "terrorist threat" could be invoked whenever some politician or police agent decides he or she wants to spy on people. Only now, the spying could easily obtain almost any information about your life—by tracking your cell phone location, your purchases, your car, the material you download and messages you send, your location at work (through employee badge data), in addition to tracking you directly with advanced tracking devices, satellites, and sensors. But, terrorists still walk free.

Some local governments, particularly in the U.S. and England, have become so frustrated with crime that they have installed video cameras on every corner and in every police car. By digitizing the video feeds, automated tools can watch and listen to many events simultaneously. Any potential crimes can be flagged and brought to the attention of a human guard. Beyond the deterrence effect, the data

Reality Bytes: Opt Out Lists

Stop telemarketing phone calls:
www.donotcall.gov

Stop some junk mail:
Mail Preference Service
Direct Marketing Association
PO Box 643
Carmel, NY 10512

Stop credit agencies from selling your address to credit card companies:
Credit Bureau Screen Service
888-567-8688

records are also useful for identifying and prosecuting criminals. But, what will happen when face recognition technology improves and an automated system can track every person every day? Try reading some science fiction novels, such as *Colossus*, for a few ideas.

Protecting Your Privacy

Despite the shortage of laws, you can take several actions to protect your privacy and restrict access to personal data. First, it is your responsibility to direct employers and companies you deal with to not distribute your personal data. You can also ask them why they need personal data and whether it is optional or required. In particular, all federal agencies are required to explain why they need data from you and the purposes for which it will be used. You can also write to direct-marketing associations and file a request that your name not be included in general mailings or unsolicited phone calls. By using variations of your name or address, such as changing your middle initial, you can keep track of which organizations are selling personal data. In some cases, you can refuse to give out personal data (such as a Social Security or taxpayer identification number). If a private company insists, simply stop doing business with it. In a world where firms increasingly rely on a single number for identification, it is important that you protect that number.

With most government agencies and with banks, creditors, and credit-reporting agencies, you have the ability to check any data that refers to you. You have the right to disagree with any inaccurate data and request that it be changed. You can also file letters of explanation that are reported with the original data. In 1994, Congress updated the Fair Credit Reporting Act of 1970. The new version requires credit bureaus to verify disputed information within 30 days or delete it. Businesses that provide data to the credit agencies would also be required to investigate claims of incorrect information. The bill also limits who can have access to the data stored by the credit agencies and controls how it can be used in direct marketing campaigns. In 1994, according to the Associated Press, the bureaus processed 450 million files, selling 1.5 million records a day and handling almost 2 billion pieces of data every month.

Reality Bytes: Pineda v. Williams-Sonoma and Her ZIP Code

A common thread in marketing is to identify your customers. One simple approach is to ask them for a ZIP Code when customers check out. Most people assume the data is needed by the credit card company, but it is not. It is just used to track customers. Detailed Census data can then be paired with the ZIP codes to estimate income and other statistics about customers. Yet, some customers feel pressured when asked for personal data. In California, it is no longer legal for retailers to ask for personal data. A 1990 state law prohibits merchants from recording personal identification information; but merchants commonly ignored it—at least in terms of the ZIP code. In 2009, Jessica Pineda purchased items at a Williams-Sonoma store which asked for her ZIP code. The merchant then used her credit-card number and ZIP Code to retrieve her home address and add her to the catalog list. She began receiving catalogs and other mail from the company. It is likely that the vendor also sold her information to other companies. In 2011, the California Supreme Court ruled that a ZIP Code constitutes "personal information" and it is illegal for merchants to ask for it. A ZIP Code might seem innocent, but with huge databases, it seems that ZIP Code, gender, and birthdate are sufficient to identify most people.

Adapted from Scott Thurm, "California Court Says Stores Can't Ask for ZIP Codes," *The Wall Street Journal*, February 10, 2011.

Privacy Laws and Rules

The United States has few laws regarding privacy, although a few states do offer some stronger protections. On the federal level, the Bork Bill states that video rental stores and libraries cannot release their rental data. It was passed by Congress when some over-zealous reporters obtained the video rental records of a judge nominee (Bork). The 1974 Family Educational Privacy Act prohibits schools from releasing grade data without permission from the student. The Privacy Act of 1994 placed some minimal limits on the sales of state and local driver's license data. The Privacy Act of 1974 limits what data can be collected and shared by federal agencies. However, various rules, interpretations, and practices have created enough loopholes to circumvent most of the original provisions.

In terms of financial data, various laws give consumers the ability to obtain their credit records once a year and the right to dispute items in the report and have the dispute resolved within 30 days. In 2001, a federal rule took effect that was initiated by President Clinton to provide some control over the use of medical data. Health care providers already complained about the high cost of implementing the provisions, and some of the provisions were withdrawn when George W. Bush became president. Nominally, the rules state that transfer of data (particularly prescription drug data) requires permission from the patient. However, most healthcare organizations require customers to sign waivers enabling them to share data.

In contrast to the United States, the European Union has stronger consumer privacy laws. Most EU nations have adopted the European commission's 1995 Data Protection Directive. Since 1978, France has had its own strict Data Protection Act. The laws basically state that personal data can be collected only with the user's permission, the user must be clearly told how the data will be used, and the

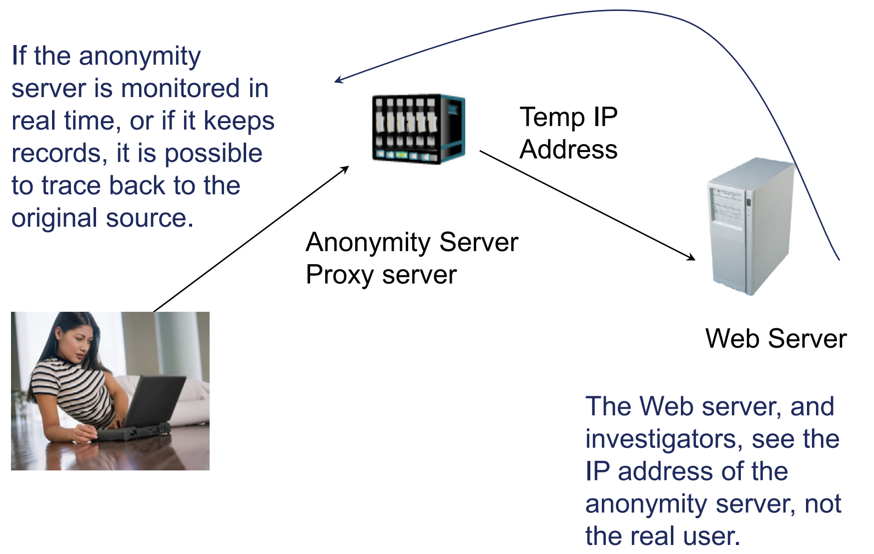


Figure 14.7

Anonymity server. By passing requests through a proxy server, the Web site server sees the IP address of the proxy server, not the original source. However, if the anonymity server is monitored in real time or keeps logs, it is possible to trace back to the original computer.

user has the right to see and to change any personal data. The laws have an additional important condition: personal consumer data cannot be moved to a nation with lesser privacy controls—notably the United States. The United States has negotiated a loose "safe harbor" provision, so that companies can bring European consumer data to the United States if the companies formally agree to abide by the EU directives and also agree not to resell the data. These provisions make it more expensive to collect data in Europe—sometimes beyond the price of small businesses. For example, in the United States, it is relatively easy to purchase e-mail lists of potential customers for a few hundred dollars. In Europe, these lists would generally be illegal to use, since the customer did not agree to the unsolicited use of his or her address.

Anonymity

Anonymity is the flip side of the privacy question. Until recently, it has been difficult or impossible to provide anonymous access to the Internet. Using advanced encryption, some firms now offer people the ability to use the Internet without revealing any data about themselves. Remember that the Internet works by assigning IP addresses to all computers. Any server that you visit saves your IP address in log files. It can be somewhat difficult to match an IP address to a specific individual, but it provides a general location. If necessary, a court order can be obtained to track an IP address to a specific individual. However, Figure 14.7 shows that a proxy server can hide your IP address. Sites that you visit see only the address of the intermediate server. The server also intercepts all cookies and other files sent by some servers. However, if the anonymity server keeps logs or if it is monitored in real time as data is being transferred, it is easy to trace sessions back to the original source. The primary U.S. wire-tapping law, Communication Assistance for Law Enforcement Act of 1994 (CALEA), was interpreted in 2006 to require that all ISPs must provide the ability to invisibly tap Internet connections and provide real-time feeds to a law enforcement agency when ordered by a court. Because of these laws, truly anonymous servers cannot exist within the United States, but a few are run by various people around the world. It is not clear whether they can be monitored in real time or are subject to court-ordered retrieval of data.

The ultimate question that you, as an important member of society, must answer is whether anonymity should be allowed, or how it should be controlled. Certainly it can be used to improve privacy. People who have a stronger belief in personal privacy might seek out and use anonymity servers—others will decide that privacy is not an issue. But what about drug dealers, terrorists, child pornographers, and other illegal activities that society wishes to stop? Or what about anonymous harassment? Someone could use the technology to harass and intimidate people on the Internet. Perhaps society should not allow anonymity? On the flip side, who makes that decision? If some nation chooses to ban dissenting viewpoints, or if a government whistleblower needs to protect a career or a life, anonymous sites can be valuable tools to increase information and open discussions.

Jobs

How does technology affect jobs? If computers do more of the work, what jobs are left for people? Technology can affect jobs in other ways as well. It opens up the world to people with physical disabilities. By removing location as an issue, networks make it possible to work on jobs from almost anywhere in the world. You can telecommute or consult around the world without leaving your home.

Loss of Jobs

There is no question that technology causes some workers to lose their jobs. In the 19th century, Luddites reacted to textile automation by destroying machines. Information technology is no exception. Norbert Weiner, a computer pioneer in the 1940s, predicted a major depression would result from computers replacing workers. Despite these predictions, during the last 100 years technology has increased the number of jobs and raised the standard of living for most workers. Since the introduction of computers in the 1950s, the world's economies have grown and incomes have increased. However, individual workers can lose jobs in the short run. Even in the long run, lower-skilled workers experience greater difficulty in finding new jobs. Compare the automated shipyards of Singapore to those in the United States. In Singapore, one man using computer screens and a joystick moves hundreds of containerized cargoes without ever leaving his office. In the United States, each crane requires a crew of four workers, including one just to identify shipments and destinations that are handled by computer in Singapore. In Europe, the Dutch port in Rotterdam cut employment in half by installing robotic cranes and automated transfer vehicles.

The point is that some jobs will disappear, but others will take their place. In the shipyard example, more technical expertise will be needed to program and repair the equipment. Figure 14.8 shows the changes in jobs for the next few years

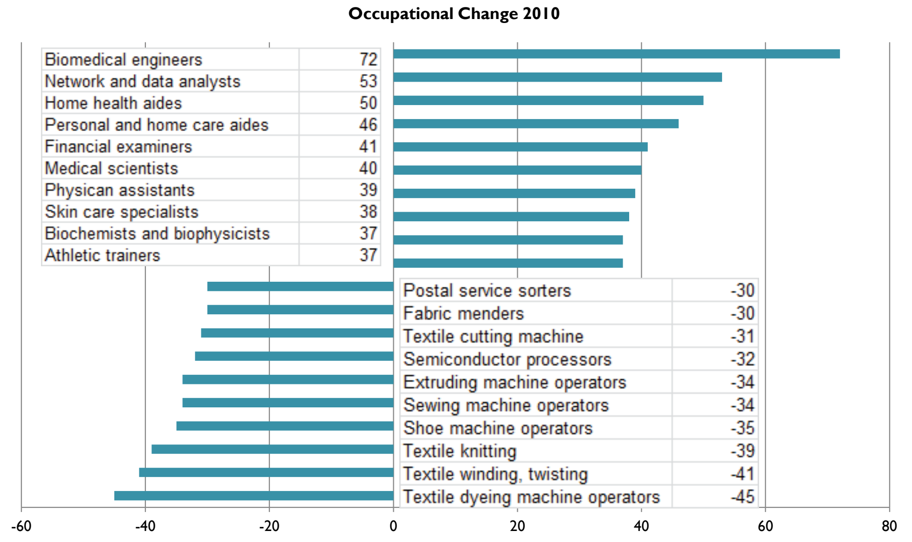


Figure 14.8

Future jobs. Today there is no guarantee that your job will continue to exist. Demand for specialists changes constantly. Jobs that are well defined and require little innovation or thought can usually be performed easily by computers.
U.S. Bureau of Labor Statistics. http://www.bls.gov/emp/

that are anticipated by the Bureau of Labor Statistics. Although they do not make the top-ten list in 2010, a few of the fastest growing jobs are in computer technology. But due to outsourcing and cost issues, the list is shorter now than it was a couple of years ago.

Most economic experts believe that technology increases the total number of jobs. New technology creates demand for people to design it, manufacturing firms to produce it, and people to maintain and repair it. Computer hardware also creates demand for software programmers. More important, technology can cause the economy to grow, creating more jobs in all sectors. By most indications, new jobs created by technology tend to be higher paying, physically safer, and less repetitive than those replaced by technology. Information technology can also reduce product prices, raising the standard of living by enabling people to buy more goods. On the other hand, technology typically causes some workers to lose their jobs. Unfortunately, many of these displaced workers cannot be retrained for the new jobs created by the technology. Similarly, the new jobs might pay less money, have lower status, or might have less desirable work environments. As computers and software become increasingly powerful and intelligent, it encroaches on even more jobs. The U.S. recession starting in 2008 resulted in many companies reducing the number of workers—particularly in middle management.

Governments have created several programs to provide benefits of money, retraining, and relocation to workers who lose their jobs. Managers need to understand the effects on employees when new technology is introduced. Many corporations provide ongoing educational payments and training classes to help workers improve their skills. Others provide out placement services to help unemployed workers in their job search.

As individuals, we need to remember that changing technology can eliminate virtually any job. One of the best plans is to continue your education and learn new skills. Remember that technology continually changes. Some of the skills you learn today will be obsolete in a couple of years. We must all continually learn new skills and adapt to changes. Applying these skills in your current job adds experience that will help you find a new job. It also benefits your current employer and might help you keep your job or stay with the company if new technology makes your current job obsolete.

The concept of continually acquiring new skills sounds straightforward. However, many times you will have to choose among multiple technologies. Guessing wrong can lead you to invest time and money in a technology or skill that fades away. As you become more involved with technology, you will increasingly find it necessary to "predict" the future. Identifying trends and deciphering fact from rumor are important skills to learn.

Physical Disabilities

Technology offers many possibilities to provide jobs for workers with physical disabilities. In fact, in 1992, the U.S. Congress passed the Americans with Disabilities Act, stating that companies are not allowed to discriminate against disabled employees. Common uses of technology include the use of scanners and speech synthesizers for visually impaired workers; voice input devices and graphics displays for workers who cannot use keyboards; and telecommuting for those who work from home. In 2001, the U.S. government began requiring that all software it purchases must be accessible to users with disabilities. Since the federal government employs hundreds of thousands of workers, this order should encourage all software providers to improve their software.

Most Windows-based software contains features to facilitate usage by people with various physical challenges. In some cases, additional accessibility tools can be downloaded or purchased to provide more features. Speech recognition packages are useful for many applications. Sometimes adaptive devices are needed to provide alternative ways to enter data and obtain the results.

Web sites still present accessibility problems, particularly for those with visual impairments. Many sites rely on color and graphics, which are difficult for the accessibility tools to interpret. These issues are being discussed by many vendors. Check Microsoft's accessibility site for more details.

Telecommuting

The fact that about 70 percent of U.S. jobs are service-based raises interesting possibilities for workers. Many services like accounting, legal advice, education, insurance, investments, data analysis, computer programming, and consulting are not tied to a physical location. As a service provider, you could be located anywhere and still perform your job—as long as you have the appropriate telecommunications system. As communication improves to include video links and faster document transfer, even more jobs can be performed from remote locations.

Some companies are experimenting with home-based workers, especially in cities such as Los Angeles and New York with long commute times. Some workers like the concept; others try it for a few months and return to a traditional workplace job. Several advantages and complications arise from the perspective of the worker, the firm, and society.

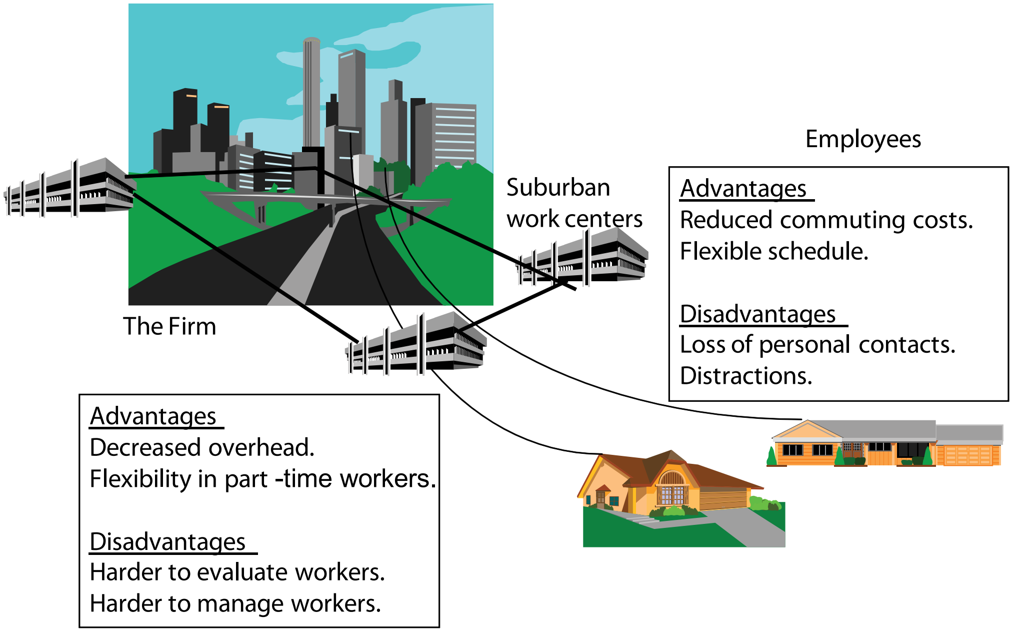


Figure 14.9

Telecommuting. In the simplest form of telecommuting, individual workers connect to office computers from their homes. An intermediate method has been used to avoid the problems of distractions and the cost of creating a home office. Workers report to satellite centers in their suburban neighborhood. Workers retain a structured environment but reduce their travel time.

If a substantial number of workers choose to work from home, the firm gains two main advantages: (1) decreased costs through smaller offices, and (2) flexibility in hiring additional workers on a contract basis. Some people have predicted that companies might also gain from increased use of part-time workers, thus avoiding the cost of insurance and other benefits. The greatest complication to the firm is evaluating and managing employees. Without daily personal contact, including conversations, it is harder to spot problems and make informal suggestions as corrections.

To the worker, the most obvious benefit lies in reducing the time and expense of commuting to work. The biggest drawback lies in the loss of personal contact and daily ritual of a typical work schedule. Depending on your home environment, there can be substantially more interruptions and distractions at home. It is also more difficult to "get away" from your job. Working from home on a flexible schedule requires strong motivation and organization. Before you choose to work at home, talk to someone with experience.

A few firms have experimented with intermediate telecommuting options. As indicated in Figure 14.9, the firm leases smaller offices in city suburbs and workers operate from these satellite offices instead of one central location. The offices are linked by high-capacity telecommunication lines. Workers keep a traditional office environment but cut their commuting costs. Businesses maintain traditional management control but do not save as much money.

A few people have speculated about the effects on society if there is a large shift to telecommuting. At this point, there is not much evidence to support any of the hypotheses, but many of them focus on negative aspects. People could become isolated. Jobs could become highly competitive and short-term. Firms could list projects on the network and workers would compete for every job. Workers would essentially become independent contractors and bear the responsibilities and costs of insurance, retirement, and other benefits, with little or no job security. They would also have no loyalty to any particular firm. Firms could become loose coalitions of workers and teams that are constantly changing, with little control over future directions. It is hard to predict what will really happen, but by understanding the negative effects, they become easier to avoid.

Business: Vendors and Consumers

How does technology change the relationship between businesses and consumers? Business consists of transactions. Changes in the way transactions are handled can alter society. In particular, as digital content becomes more important, can the existing laws created decades ago still be applied? And if the laws are replaced, will they affect the balance of power in the relationship between vendors and consumers?

Intellectual Property

Intellectual property is the general term to describe ownership of ideas (patents) and creative expressions (copyrights). For many years, there was a solid distinction between the two: ideas involving physical items (such as machines) could be patented. A **patent** essentially grants a monopoly to an inventor for a fixed period of time (originally 17 years in the United States but now 20 years). During that time, no other company can introduce a similar device—even if the second creator did not use any knowledge from the first inventor. A **copyright** is created for other creative works—traditionally writing and music. It protects the specific article from being copied and grants the owner the sole right to create derivative works (such as a sequel). But it does not prevent others from creating similar works. For example, one person could write a story about space explorers. Someone else could also write a story about space explorers, and it would not be an infringement on the first story. If the second story used the same characters and plot, it might be an infringement, but it might not, depending on the interpretation of the courts. In the mid-1990s, the U.S. patent office began granting patents for nonphysical items—specifically for business ideas. Patents were supposed to be granted only for nontrivial ideas, but for a while, the patent office got carried away and forgot that patents are only supposed to be granted for "nontrivial and nonobvious" inventions. For instance, it granted a business process patent to Amazon.com for one-click checkout of Web sales; so no other Web site was allowed to offer a checkout system with a single click without paying royalties to Amazon.

The goal of patents and copyrights is to encourage creativity by offering protected rewards to innovators. Remember from economics that without a barrier to entry, any firm that makes a profit will attract competitors. Patents and copyrights are designed to be barriers to entry for a limited time. But the laws were written in decades when the goal was to protect companies from other companies. For instance, before computers, only a large company would be able to copy a book and reprint it. The laws made it clear that this action was illegal, and the injured party could easily find and sue the single violator for damages. Several exemptions to

Reality Bytes: Cignet and Massachusetts General Fined for HIPAA Violations

The U.S. Department of Health and Human Services (HHS) is in charge of enforcing the provisions of the Health Insurance Portability and Accountability Act (HIPAA). Two major features of the rules are that patients can receive copies of their health records and that medical institutions must protect the privacy of patient data. In 2011, HHS completed enforcement actions against two companies based on separate violations of those provisions. The insurance company Cignet had failed to provide records to patients in a timely manner. The company also failed to cooperate with investigations and to produce records to HHS. Cignet paid a $1.3 million penalty. Massachusetts General Hospital faced a different problem. In March 2009, an employee of the Hospital accidentally left health documents for 192 patients on a subway train. The Hospital ended up paying HHS $1 million in fines. The two actions represent the first fines imposed due to HIPAA. Perhaps the actions will help convince businesses to protect customer data. But much remains to be done. A report from the accounting firm Kaufman, Rossin & Co. revealed that in 2010 businesses somehow gave up or lost health data on about 5 million patients.

Adapted From Jaikumar Vijayan, "HIPAA Privacy Actions Seen as Warning," *The Wall Street Journal*, February 25, 2011.

the copyright law were specifically created to support important noninfringing uses that are considered valuable to society. For example, educational institutions can make limited copies of items for discussion and research.

The basic laws made sense when large companies were the primary threats to copying products and content. Only large print shops, music firms, and competitors had the money, tools, and distribution networks to become a serious threat. For example, the music industry did not consider cassette tape copies made by individuals as a serious threat.

Digital content changed most of the underlying assumptions of the intellectual property discussion. First, it is easy for anyone to make perfect copies. Second, it is equally easy for everyone to distribute those copies—at virtually no cost. Instead of a large competitor, now the threat is millions of your own customers. Some of these issues are cultural and economic. For example, some industry-sponsored reports indicate that software piracy in Southeast Asia is huge: over 90 percent of software in use is copied. Nations such as Vietnam do not have the tradition of paying for creative works, and do not have much money to pay for them.

The most famous case of these copyright issues involved the company called Napster. Napster was a pure Internet firm that ran a Web site to make it easy for consumers to find and share digital music files. In an attempt to stay within the copyright laws, Napster did not store any files and did not charge for its services. Instead, it was simply a giant directory. Individuals searching for specific songs went to the Napster site, found a fellow enthusiast with a desired file, and copied the file from the other's machine. Napster lost the ensuing lawsuit from the music industry. But the battle is far from over. Napster made it easy by providing a single target to sue. What if there is no central company directing the copying? One such firm, LimeWire, was shut down in 2011 for violating copyright laws by providing software for "sharing" music.

Technology Toolbox: Privacy

Problem: How do you improve privacy on the Internet?

Tools: Most current browsers have tools for improving privacy by reducing the data exchanged with Web sites. But, browser vendors tend to hide these tools because most receive large amounts of advertising money that might be disrupted. Also, stronger privacy sometimes makes Web sites unusable or harder to use.

Microsoft Internet Explorer (IE) has a couple of privacy controls. The simplest one is to control the use of cookies. In particular, you should disable third-party cookies. These are installed and used almost exclusively by advertising companies such as Double-Click (Google) to track which sites you visit. To disable them, use the main menu (press the Alt key) Tools/Internet Options/Privacy tab, then select the Advanced button. First-party cookies should be set to Accept, and third-party cookies set to Block. If you have problems with some sites, you might set it to Prompt, but that will generate warning messages on almost any site you browse. IE9 and above has a new option under the Privacy tab to "Never allow websites to request your physical location," that you might want to select. If you are going to browse a Web site for research or where you want to ensure absolutely minimal tracking and minimal history, IE provides the InPrivate browsing mode. Start IE then click the small new tab icon on the tabs row. Find and click the link for "InPrivate Browsing" which will open a new browser window. In this mode, minimal information is exchanged or stored on your computer.

The Google Chrome browser has similar settings under different names. To block third-party cookies, click the Settings icon and choose the Under the Hood tab. In the Privacy section, click the Content Settings button. In the Cookies section, check the option to Ignore exceptions and block third-party cookies. Chrome also has a mode that does not save any cookies, temporary files, or history. Click the Settings icon and pick the New Incognito Window option.

Firefox and IE have a new option to "Tell Web sites I do not want to be tracked." The problem with this option is that it is not yet a standard and none of the Web sites actually support it. Firefox has a "private browsing" option. Press the Alt key to activate the menu, choose Tools/Start Private browsing.

At the server level, it is also useful to opt out of some Web site tracking. A big one is to opt out of Google: http://www.google.com/privacy/ads/, which includes getting rid of Double-Click tracking.

Quick Quiz:

1. Can you prevent Web sites from collecting your personal data?
2. What do you gain by blocking third-party cookies?
3. Why would you not want to use "Private" or "Incognito" browsing all the time?

Reality Bytes: Dirty Politics Goes Online

It is unlikely that anyone likes political campaigns, but they are a necessary component of a democratic society. On the other hand, political campaigns that become "dirty" are even more annoying. Apparently, political consultants are now working with technology practitioners to generate online attacks. Someone hacked and released thousands of e-mails from HBGaary Federal, a security consulting firm. The messages show that the company pitched ideas to lawyers at Hunton & Williams, a D.C. law and lobbying firm. The ideas included create fake social network accounts to mislead people, scanning Facebook and other accounts to find negative information about opponents, and planting false documents to undermine the credibility of activists. Workers from HBGary Federal, Berico, and Palantir suggested many ways to spread disinformation online. It is not clear whether the actions would be illegal or if any were actually undertaken. But, given the challenges of tracking actions online, it is only a matter of time before dirty tricks become more common.

Adapted from Dan Eggen, "Hacked e-Mails Show Web is an Increasingly Useful Tool in Dirty-Tricks Campaigns," *The Washington Post*, March 4, 2011.

In response to these problems, content providers began encrypting their content to make it more difficult to share. Cable and satellite TV providers were among the first to scramble their signals to make it more difficult for people to steal the signals. In response, several companies started selling and advertising black boxes that would descramble the signals, making it possible for anyone to steal the TV signals. Technically, it was illegal for people to steal the signal, but it was economically difficult for companies to stop the theft.

To solve this problem and help protect IP rights, the United States passed the Digital Millennium Copyright Act (DMCA). One of the most important changes in the act is a provision that makes it illegal to circumvent any copyright protection scheme. For example, this provision made it illegal for companies to advertise and sell TV descramblers. The law was generally accepted in terms of hardware issues, but problems and complaints quickly arose when circumvention focuses on software and information.

In existing cases, the DMCA provision has been interpreted to mean that any discussion of how to circumvent protection is illegal. The first case pursued under this provision relates to DVD movie disks and the DeCSS program. DVD files are encrypted so that they can be played only on specific machines with authorized software. The files are only weakly protected. Direct from the manufacturer, the files can be copied to other computers, but can only be viewed with the special software. Since that software did not originally exist for some computer systems (notably Linux), a few experts found a way to defeat the encryption. They posted this method (known as DeCSS) on the Internet. The movie studios promptly sued every Web site that carried the program for violating the DMCA. Many people are concerned that these actions violate the spirit of free speech and open discussion. Of course, whether or not the movie industry wins the case is almost irrelevant. One key factor of the Internet is that it is impossible to destroy knowledge once it has been created. Several Web sites in foreign nations that do not support the DMCA carry the information.

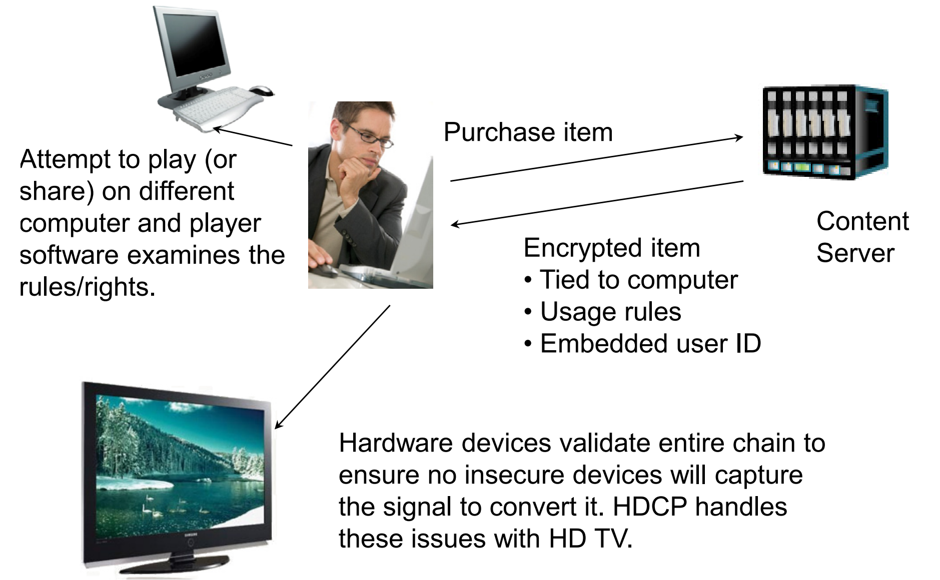


Figure 14.10

Digital rights management. When digital content (music, books, movies, and so on) is purchased, it is encrypted with a set of rules that tie it to the purchaser's computer. Software on other computers checks the rules to decide whether the data can run on other machines. HDTV goes a step further and verifies the security of the hardware before sending data.

Computer software, music and digital books face similar issues. As more content moves online, creators and publishers searched for a stronger solution that will prevent customers from copying and sharing digital data.

Digital Rights Management

Digital rights management (DRM) tools use encryption and rules embedded in the data to control how purchasers can use and transfer data. Figure 14.10 shows the basic concept. Several companies provide DRM tools, leading to different approaches, but many of them follow a similar process that is pushed heavily by Microsoft. When an item is purchased, software on the purchaser's computer creates an identifier for that machine and sends it to the server. The server encrypts the data, embeds a set of rules, and often embeds a user ID. If the content publisher finds an illegal copy of a file online, it can be traced back to the original purchaser. To date, no one has tested this concept in court to see if it could be held against the original purchaser. As a simple defense, the purchaser could argue that a virus or Trojan Horse copied the file invisibly.

For DRM to work the software that plays or displays the file must know how to decrypt the file and it must follow the embedded rules. Even if the file is transferred to a different computer, the software will not play the file if the rules are not met. Most systems accomplish this task by requiring that the file be played with a specific software package. For example, originally files purchased through Apple could be played only with the iTunes software, and files protected with Microsoft DRM could be played only with Microsoft media software. The process becomes more complicated if the data needs to be compatible with multiple devices created by different manufacturers. HDTV is the primary example. You can buy a Blu-Ray disk created by several companies, play them on several different players and connect the player to any television. To protect the content, all of the manufacturers had to agree on the **high-bandwidth digital content protection (HDCP)** format.

Effective DRM is difficult to create. For example, music eventually is converted to analog form and played through speakers. It is relatively easy to convert it back to digital form that is no longer protected—but some quality might be lost in the process. HDTV took the process a few steps further. The high-definition players examine the entire collection of devices, including the connecting cables, to ensure that all of the devices support HDCP. If not, it plays the video in a lower-quality picture. Some early devices even required the video output to be directly connected to the display device (TV).

Many people look at DRM as a challenge—something to defeat simply because it is there. In theory, any DRM scheme can be defeated—given enough time and effort. Programmers have full access to the computer so they can trace every step in the process. Technically, DMCA makes these efforts, and publishing it, illegal in the United States; but it will not stop the work.

The flip side of copyrights is the argument that content should be free. But who would take the time to create useful content if it is free to everyone? Stephen King, the noted author, ran an experiment in the late 1990s. He wrote a novella and began writing a novel in installments. He distributed them through his Web site. He attracted hundreds of thousands of visitors and free downloads. He ultimately stopped the projects because of lack of revenue (it was more profitable for him to devote his time to paying projects).

At this time, DRM is a highly contentious issue. It makes life more difficult for honest consumers and limits what they can do with the data they purchased. For example, imagine the problems that can arise if all of your music is locked to one computer and that computer dies. Even if you have backups, you will need special permission to transfer them to a new device. Many companies establish rules to support using the content on three or four computers, but that rule will not cover a lifetime of upgrades. In 2007, Steven Jobs, the CEO of Apple, attempted to convince the music industry to allow him to drop DRM conditions on the songs his company sells.

By 2011, most digital music was sold without copy protection (DRM). Does that mean consumers became more honest? Certainly, it is now easier to purchase music online, particularly individual songs. Some prices have dropped with competition. But, the music industry continues to report declining revenues from all forms of music sales. (For some interesting charts, see http://www.businessinsider.com/these-charts-explain-the-real-death-of-the-music-industry-2011-2.)

DRM presents an interesting dilemma to businesses that sell digital content. The fear is that if you do not include DRM, everyone will copy your content and "share" it with others, reducing the number of sales. But, if you do use DRM, you make life more difficult for legitimate users who pay for the product. For example, as of 2011 most book publishers sell DRM-protected books for electronic readers. Effectively, the DRM locks the book to specific devices. Customers run the risk of losing their existing books if they switch to a different device, or even if a device breaks or is lost. In the meantime, the DRM methods were generally broken, with methods available online, within a few months. Additionally, almost anyone could

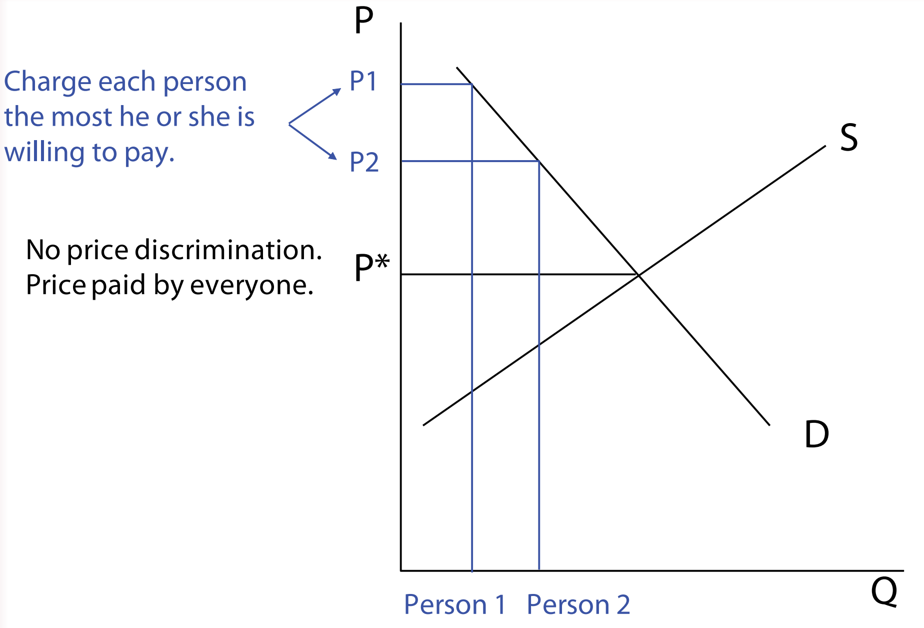


Figure 14.11

Price discrimination. By selling directly to individual customers one at a time, it becomes possible to find and charge the maximum amount each is willing to pay. This action shifts profits/benefits from consumers to producers.

use a scanner to turn a print copy of a book into an unprotected digital copy in less than an hour. Similar issues face publishers of music, movies, and software. Music moved away from DRM largely because of the decision to avoid locking music to specific devices. Movies continue to cling to DRM. Software varies, with big publishers such as Microsoft and Adobe leading the way with DRM (their software uses Internet connections to limit the number of installations.) Clearly, it is within the rights of the copyright owners (publishers and authors) to choose to implement DRM. Also, in the U.S. the DMCA makes it illegal to circumvent DRM protections (although this provision is largely untested in court). But, from a business perspective, managers need to think about exactly what is gained and lost through DRM.

Balance of Power

Some of the issues with intellectual property arise because of questions of balance of power between the creator, the publisher, the retailer, and the consumers. For instance, the Internet, with its digital content, provides the opportunity for authors and creators to circumvent the traditional publishers. Currently, authors receive only a small portion of the list price of an item. Retailers, distributors, and publishers take the majority of the money. In a world that requires distribution of physical items, these are the costs artists must pay to reach consumers. In a digital world, anyone can sell products directly to consumers. Of course, it will be simpler and more cost-effective when consumers adopt a small-payments mechanism. The point is that the few large publishers in each industry have a strong interest in

Reality Bytes: Poker is Not Gambling?

U.S. law makes it illegal to gamble "by wire" which includes Internet gambling. Online casinos and games of chance were banned shortly after the Web became popular. Federal law prohibits credit card companies from transferring money to online casinos. But, for several years, online poker sites flourished—even in America. Credit card companies did not transfer money to them, but a few banks handled special accounts for them. In April 2011, Federal authorities cracked down on the online poker sites. Initially, eleven people were arrested, including three founders of the largest poker sites. Federal agents filed restraining orders against 76 bank accounts in 14 nations; alleging at least $3 billion in money-laundering penalties. PokerScout, a site that tracks playing, estimated 1.8 million U.S. players wagered $16 billion in 2010. About one-third of the money deposited by players ended up going to the online companies as the "rake" or house percentage. Prosecutors also seized five of the Internet domains used by the poker companies, shutting down the services and putting up warning notices. In their defense, the arrested founders argued that the sites are not illegal because poker is not gambling.

Adapted from Alexandra Berzon and Chad Bray, "Eleven Charged in Federal Crackdown on Online-Poker Companies," *The Wall Street Journal,* April 16, 2011.

maintaining control over the distribution system, so most proposals have catered to these large firms. For example, the DRM systems keep the role of the retailers and the publishers, so the costs to consumers are likely to remain high.

All of these issues are challenging with multiple perspectives. Society needs to protect and encourage innovation because it creates new products and moves the economy and society forward. But, in these cases, technology also makes it easier for individuals to copy and distribute protected works, and it is economically infeasible for an innovator to sue millions of people over patent or copyright violations. The issues also revolve around important economic concepts. Digital content essentially has zero cost to copy and distribute (but high fixed costs to create).

As shown in Figure 14.11, another interesting economic issue is that some people are willing to pay higher prices for the content than others are. In a typical market, the price is determined by supply and demand so that the market clears with no shortages or surpluses. Effectively, everyone pays the same price (or close to it). People who were willing to pay more money for a latest release got a deal (or consumer surplus) because they paid the same fixed price. But, in an online digital world, it is possible that the customer will purchase directly from the producer. Every sale is separate, and individuals might not even know how much others are paying—particularly if you want to buy a newly released item. In this situation, it is possible to set up a system where each customer pays his or her highest price—perhaps through an ongoing series of auctions. For example, if you want to be the first person to download a specific song, you will pay more. If you are willing to wait a few days or weeks, you can pay a lower price. Or, more sophisticated methods could be created. In the end, each person pays a different price, but one that each is willing and able to pay. The balance of power is changed and the producer captures more of the consumer's money. Is this situation good or bad? The answer depends heavily on your personal beliefs, but it is certainly different. When Amazon tried an experiment several years ago, (the company charged dif-

Can technology improve education?
- Computer-assisted instruction to provide individual attention
- Course management
- Distance learning

Do people want more technology in education?
- Teachers
- Students
- Employers

Are the answers different for lifelong learning?
- Professionals
- Employers
- Military

Figure 14.12

Information technology in education. The technology has the potential to change education, particularly in terms of individualized attention, course management, and distance. But it is expensive and time consuming to provide the infrastructure and create new applications. Nontraditional areas such as continuing professional education (CPE), employer training, and the military have found several benefits in the technologies.

ferent prices for the same book in different cities), customers were unhappy when they found out some people paid a lower price. Apple negotiated with the studios to be able to charge different prices for each song. Popular, newly-released songs cost more than older songs. It is not perfect discrimination, but someday new pricing mechanisms might be introduced that add even more levels of prices.

Education and Training

Can information technology change education? For hundreds of years, the principles and techniques of education have changed only slightly. As new technologies are introduced, people have often declared that the world of education would change markedly. Yet, few technologies have had a lasting impact on education. Television is a classic example. Although movies and news reports are sometimes used for teaching purposes, the role of television in formal education is minimal. However, it is used for informal education and for training, especially with the availability of videotapes for teaching specific tasks. And, as bandwidth has increased, video communication is growing as a way to connect with students in distant locations.

One of the drawbacks to video education is the lack of interaction and feedback. Multimedia tools that combine video, sound, and computer interaction represent one attempt to surmount this limitation. However, three basic problems arise when applying technology to education. First, technology is often expensive, especially compared with traditional methods. Second, it is time consuming to create lessons that generally are difficult to change. Third, there is little conclusive evidence that the techniques are equal to or superior to existing techniques. Especially in light of the first two problems, it is difficult to test the new technologies. In many cases, by the time prices have fallen and lessons are created, an even newer technology emerges.

Despite these obstacles, technological innovations are often used for specialized teaching purposes. For instance, interactive and multimedia computer tools can be used to provide more in-depth study for advanced students or to handle repetitive drills for those students needing extra work. Increasingly available two-way video links are used to connect teachers and students in remote locations.

The main questions regarding technology in education are summarized in Figure 14.12. Note that nontraditional areas have been faster to adopt the technologies, for example, business training classes—partly to reduce the cost of hiring instructors and partly because the lessons are available to workers at any time and can be studied at whatever speed the student desires.

The Internet is increasingly being pushed as a means to expand the reach of higher education. Several universities offer individual courses over the Internet. The early examples often consisted of simple e-mail-based systems where students worked on their own and occasionally sent messages to the instructor. A few organizations offer complete programs over the Internet. Improving Internet speeds have made new communication methods feasible—including interactive voice and some two-way video communication.

The real key to online education is to use all of the power of the technology to develop entirely new applications. Communication is only one aspect of the Internet. Building more intelligence into the applications to create entirely new procedures will lead to more useful tools. Researchers have worked for years to develop computer-assisted instruction tools that will provide individualized attention to each student. While some individual products have been successful, these tools require considerable creativity and effort to create.

Social Interactions

How does technology affect different areas of society? As any good science fiction book illustrates, advances in technology can alter society in many different ways. Sometimes the responses are hard to predict, and they often occur gradually, so it can be difficult to spot patterns. At the moment, four patterns appear to be important: social group power, equal access to technology, e-mail freedom, and liability and control over data.

Social Group Legitimacy

One interesting feature of technology is that it has substantially lowered communication costs, including the costs of producing and distributing information to large public groups. For example, desktop publishing systems enable groups to create professional-quality documents at low cost. Furthermore, video production facilities are easily affordable by any group, and access to mass markets is provided free through public-access channels on cable television. Web sites can be created by anyone. These technologies enable small groups to reach a wider audience for minimal cost.

The only catch is that with growing professionalism of small-group productions, it becomes harder to distinguish fact from fiction, and it is harder for the public to tell the difference between mainstream, professional commentary and radical extremists. For example, do you believe stories that are printed in *The New York Times*? What about stories printed in supermarket tabloids that sport titles such as “Space Alien Eats Movie Star”? Now consider the Internet and run some searches on medical questions. You will find hundreds of Web sites and comments. Which ones do you believe? Web sites present the strongest challenge

Figure 14.13

A test of cynicism. Which Web site do you believe? Why? Would it help to know that the one on the left is from Johns Hopkins medical center, and the one on the right from a site called arthrituscure.org? With information technology, anyone can create a Web site. It can be difficult to determine the truth. Of course, in many cases, "truth" may be only shades of gray, and there seldom are any "right" answers. All consumers must learn to challenge everything.

ever to trust and reliability issues. Literally anyone can create a site and say anything. Nonsensical comments will be found by the search engines and displayed along with accurate statements. Throw in Twitter and your cynicism meter should go off the scale. Consider the example Web sites in Figure 14.13 and see if you can determine which one to believe.

This issue has some interesting effects. For example, in several instances, disgruntled customers have created sites criticizing companies. If you search for a particular company, you are likely to encounter several of these sites. The Web makes it easy for people to criticize anyone—and the entire world can see the results. Of course, traditional defamation laws still apply, but in situations where there is an element of truth, companies will find it difficult to stop these activities.

The same issues can be applied to television broadcasts, except that for the moment, the high costs of broadcasts restrict this option to a few participants. With his "War of the Worlds" broadcast, Orson Welles shocked many listeners because they had come to accept radio broadcasts as fact. With existing technology, it is possible to create realistic-looking fictional broadcasts. It is not even necessary to resort to tricks such as hidden explosive charges. It is possible to create computer-generated images that exceed the quality of broadcast signals, so they appear to be realistic. Advertisers have made heavy use of these techniques. Every time you watch a commercial, you should remind yourself that a portion of what you are seeing is probably a computer-generated image. Now, imagine what would happen if an extremist organization used this same technology to create newscasts with altered pictures.

Technology Toolbox: Working in a Global Environment

Problem: How do you deal with multiple languages and currencies?

Tools: Foreign currency and language translation tools are available.

Global business presents several challenges. Some, such as cultural issues, are too hard to handle with technology. Others, such as foreign exchange conversion and even some language translation, can be handled by automated systems. However, before you use these systems, you need to understand their features and limitations.

Currency	1 U.S. Dollar Equals
Euro (EUR)	0.69022
Japanese yen (JPY)	80.840
British pound (GBP)	0.62269
Australian dollar (AUD)	0.92384
Mexican peso (MXN)	11.7305

Items sold in one nation are usually priced in the national currency. Products in Europe might be priced in the national currency or in euros. Currencies exchanges are handled by banks or by specialty foreign exchange (FX) brokers. Due to international trade, large banks buy and sell currencies and record the going exchange rates. Currently, the United States uses a floating exchange rate, where the rate changes constantly in response to trade and interest rate differentials. Other nations, such as China or the member European Union countries, fix their exchange rates so that they change only when major economic conditions force a revaluation. Since the rates change, you need to convert currencies on a specific date. The other challenge with exchange rates is that the commonly cited rates are from large interbank transactions. Most people do not get to use those rates and have to pay additional fees to banks or brokers. For example, many credit card transactions use the interbank rates and then tack on 2 percent as a fee. Physically exchanging currencies at a border or airport kiosk will cost you even more in fees.

Oanda is probably the most powerful online FX converter (www.oanda.com/convert). It automatically converts between any two currencies (from164) on a specified date, using interbank or typical credit card rates. You can use the system to convert prices on your Web site for customers in other countries.

Language translation is another challenge you need to solve to compete in world markets. Ultimately, you need to have Web sites (and product documentation) translated by human experts. However, if you happen to receive a note or see a Web site in a foreign language, or if you simply want to know the meaning of a few words, you can use the automated online translators. Several free translation systems are on the Web. The babel.altavista.com site is one that has been around for several years. Some experimental translation software is becoming good enough that it matches human translators. However, for now you are still better off hiring a person to translate Web sites and documents that will be read by customers. The online sites are useful for quick, approximate translations into your language. In most cases, you should be able to understand the gist of the document, even if it contains errors or poorly worded phrases. An interesting way to test the sites is to enter a phrase in your language (say, English); translate it to a second language (say, Spanish); and then ask the system to translate that phrase back (to English). See how far off it is from the original phrase.

Quick Quiz:

1. What cautionary messages do global Web sites use when converting currencies?
2. If you cannot afford a human translator, is it better to leave your Web site in English, or to use a machine translation?

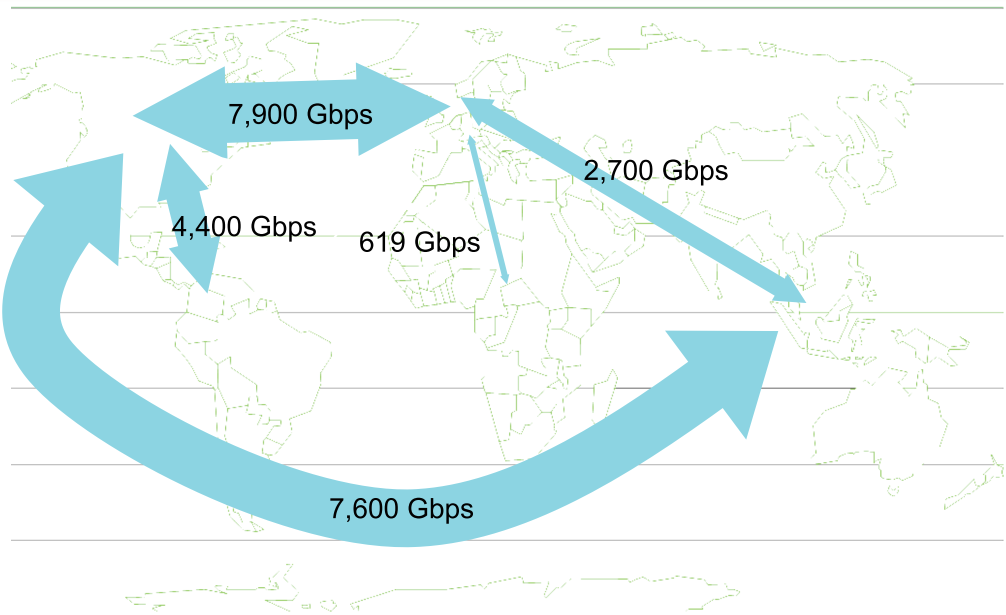


Figure 14.14

International bandwidth. Access to the Internet requires more than computers; it requires high-speed communication lines between nations and continents. As noted by www.telegeography.com, most connections are between the United States and Europe. Numbers are estimates. See/pay TeleGeography.com for better numbers.

Access to Technology

Picture a world in which financial instruments are traded electronically, goods are purchased through computer-television systems, libraries are converted to electronic media, and businesses require suppliers to exchange data over computer links. Large portions of the United States and Europe are getting closer to this scenario every day. Now, what happens to the individuals in poorer nations who can barely afford to eat, much less invest in personal and national information systems? If the means of production are based on technology and certain groups do not have access, the gap between those who have access and those who do not (the **digital divide**) will widen. Although some groups will be content to live without technology, some will become upset at the imbalance.

Figure 14.14 shows that access to the Internet requires more than simple PCs and software. Individuals need access to telecommunication lines. More important, nations need high-bandwidth connections to other nations. The figure shows the currently installed bandwidth between major world regions. Note the major connections between the United States and Europe or Asia, and the relatively small connections to Latin America and Africa. It takes time and money to install new fiber-optic connections across long distances. Telecommunication firms are reluctant to incur these high fixed costs until a region has enough paying customers to cover the costs with long-term usage.

Some companies have worked to give others access to technology. A few recycle older computers to libraries and citizen centers. On the international front, businesses can donate older personal computers to organizations for shipment to other countries. After three to five years, the technology is often out of date in the United States, but even old technology is better than nothing in some countries. The program "one laptop per child" has attempted to provide low-cost computers to schools in developing nations, but they do not run standard software. And, little work has been done to expand the bandwidth.

Wireless connections offer enormous potential to nations that cannot afford to install fiber-optic connections across their countryside. Wireless is particularly convenient and substantially cheaper to install in high-density areas.

Still, before you begin to believe that the "rest of the world" is poor and bereft of Internet access, consider that several other nations have superior Internet access than the United States. Also, note that even in developing nations, big cities, governments, and universities have computers and Internet connections. These facilities make it possible for most people to obtain access to the Internet—even if they do not have access at home.

e-Mail Freedom

Some organizations have observed an interesting feature when they first replaced paper mail with electronic-mail systems. The first people to use the technology are generally younger, more likely to take risks, and bolder than the typical employee. If the top management levels accept and respond to electronic messages, they are likely to get a different perspective on the organization, its problems, and potential solutions. E-mail systems provide a means for employees (and sometimes customers) at the lower levels to bypass the hierarchy of middle management. A few directed comments and words of encouragement can enhance this effect, which is useful if managers are searching for new approaches to solving problems.

Similarly, customers who spend considerable time on social networks and Twitter can provide useful feedback about your company. Many firms monitor these networks to identify potential problems and provide additional support to highly-connected customers.

Liability and Control of Data

Virtually all of our legal structures and interpretations were created before the advent of a computerized society. Although federal and state governments have passed a few laws specifically to address problems with computer interaction, most legal systems still rely on laws and definitions created for a paper-based world. Sometimes these concepts do not fit well in a computerized environment. For example, how would you classify the operator of a Web site? Is that person a publisher of information, like a newspaper? Or is the operator merely a vendor offering disk space to anonymous writers? In particular, are the owners of Web sites responsible for the content of messages posted on their systems? To date, the court systems have tended to make the decision based on whether the owners exercise "editorial control." In 1995, the New York supreme court ruled that Prodigy could be sued for libel. An anonymous writer posted a message that was highly critical of the financial status of a certain firm. The firm claimed that the comments were false and sued Prodigy for publishing false information. Since its inception, Prodigy maintained a policy of forbidding people to post "profane" messages. The Prodigy staff used software to scan messages. The court noted that these actions constituted editorial control, so Prodigy could be treated as any other publisher of information (like a newspaper). These concepts were later clarified into law. Now, Web sites that do not exercise control over the content are merely distribution channels (like booksellers) and cannot be held liable for the content. However, many Web hosting companies place restrictions on content (such as pornography) and will remove a site that is reported to violate its policies.

Government

Can information technology improve governments? Following the expansion of the Internet, the concept of e-government became popular. In some ways, government agencies are similar to businesses. Most federal and state agencies now provide data and communications via the Internet. Some are quite sophisticated.

Government Representatives and Agencies

Governments can be slow to adopt new technologies. Typically, government agencies have limited budgets, long procurement cycles, and requirements for special allocations to acquire new technology. They tend to have smaller IS staffs, who also receive less pay than their counterparts in private business. Moreover, government projects tend to be large and involve thousands of people, which makes them expensive, harder to create, and more difficult to implement.

In the United States, the federal government has moved many data sources to the Internet. Almost all federal data is available in computer form. Many agencies are positioning themselves as providers of economic data to facilitate business decisions. Fedstats (www/fedstats.gov) is one of the best starting points for finding data produced by federal agencies. Even municipal governments are beginning to post notices and data on the Internet. Most government agencies are still nervous about electronic commerce. One of the main problems they face is the inability to positively identify consumers over the Internet. Of course, government agencies operate on government time. Little has been done to reduce the time it takes to release government data. For example, data reports from the 2000 census were released over a five-year time period, and data from the 2010 census began slowly trickling out in 2011. Data from many agencies is months or years out of date when it is released. Furthermore, many economic statistics are revised over time, so preliminary numbers you see one month may be replaced with different values several months later. Nonetheless, the government agencies are important sources for many types of data. Government data is important for its accuracy.

Politicians campaigning for office also use technology. But, due to spam, you cannot send direct e-mail to them. Most have Web sites that enable you to enter questions or sign up for marketing spam from the politician's office. For many years government officials have used databases to track letters and comments, solicit contributions, and tailor speeches to specific audiences. Politicians still rely on television to create images, but Web sites are commonly used to provide detailed position papers and background information that is too long to be covered in depth by traditional media.

Politicians significantly use technology in election campaigns. They use databases to pinpoint donors. More aggressively, they use databases to identify voters who will cast votes for a specific candidate, then use reminders and rides to the polls to ensure those voters get to the voting booth.

Democracy and Participation

The U.S. Constitution and its amendments clearly recognize that democracy requires the participation of the citizens. And participation requires that citizens be

- Prevent fraud by voters (identify voters).
- Prevent fraud by counters.
- Prevent fraud by application programmers.
- Prevent fraud by operating system programmers.
- Prevent attacks on servers.
- Prevent attacks on clients.
- Prevent loss of data.
- Provide ability to recount ballots.
- Ensure anonymity of votes.
- Provide access to all voters.
- Prevent denial of service attacks.
- Prevent user interface errors.
- Identify and let voters correct data entry errors.
- Improve on existing 1 in 6,0000 to 1 in 10,000 error rates.

Figure 14.15

Electronic voting requirements. Electronic voting sounds convenient and easy to set up—until you look at the detailed requirements. Many avenues for fraud exist. Additionally, complex systems are hard to create and susceptible to errors.

informed—hence the importance of the press. Information is required to produce knowledge, which can lead to wisdom and better decisions. More important, it is not always clear exactly what information will be useful later. The Internet is a powerful source of information. Of course, distinguishing fact from fiction is critical. Yet today it is still possible for a nation to control the content available within its borders. China maintains its hold by owning and controlling all routers that connect to the Internet. Ultimately, it may become impossible for a nation to control all information. Between the massive data flows, encryption, automated document translation, and wireless capabilities, it will become increasingly difficult to control data.

These points were emphasized in the 2011 political upheavals in northern Africa (Tunisia, Egypt, Libya, and so on).Cell phones and the Internet gave citizens the ability to communicate and coordinate their actions. Dictators Mubarak and Gadhafi actually shut down Internet connections and cell phone networks in an attempt to restrict the ability of their citizens to communicate. (Side note to future dictators: It is really hard to convince people you are a benevolent dictator when you take away cell phones and the Internet.) Eventually, people found ways to communicate. In Libya, enterprising workers built a completely separate cell phone network.

Voting

With the fiasco of the 2000 U.S. election, people began to realize the deplorable status of existing voting systems. The level of mistakes due to machine, user, and counter error is unacceptable in a modern society. Several people have mentioned the possibility of creating electronic voting systems to provide faster and more accurate tallies of votes. But many challenges exist as shown in Figure 14.15. Several experts have testified before Congress that they do not believe current technology is capable of surmounting all of the problems. But ultimately, the question comes down to whether a superior system can be developed, even though it may

Reality Bytes: Where Have You Been?

In 2011, researchers looking at cell phones noticed that Apple iPhones and Google Android phones routinely tracked the cell phone location and stored the data in an unprotected file on the phone. Both Apple and Google later admitted that the phones regularly sent the location data to their corporate computers. Both companies apparently used the data to build a location database. Apple and Google are not alone. A Wall Street Journal examination of 101 popular apps found that 47 of them sent location information to app vendors and other companies. Once the data is collected, no rules exist, so it can be sold to anyone else.

Adapted from Julia Angwin and Jennifer Valentino-Devries, "Apple Receives iPhone Location Data," *The Wall Street Journal*, April 21, 2011.

not be perfect, and whether it can prevent major problems. There is a long history of building and revising voting machines in an attempt to minimize fraud and abuse. But existing machines still miscount an average of one in 6,000 to 10,000 ballots. The other serious drawback to existing systems highlighted in the 2000 election was the usability issue, where thousands of ballots were disqualified and thousands more counted incorrectly because people did not understand them.

A few people have suggested that it would be nice to implement a voting system that works as easily as ATMs or even using their own PCs to connect over the Internet. But electronic voting has two main complications over traditional electronic commerce. First, it is critical to authenticate each voter. Current e-commerce handles this step with credit cards—which are not available to all voters and not secure enough to use as a public voting identifier. (What would stop a business from assuming your identity?) Second, the votes have to be auditable, but anonymous so that no votes can be traced back to an individual. This second condition is even trickier if you are concerned about vote selling. Ideally, voters should not be able to show their final vote to anyone else. If they can, it opens the possibility of buying votes. Currently, there is little incentive to buy votes because there is no way to prove how someone voted, so no way to enforce the agreement.

Voting from your home over the Internet might take years to develop, largely because of the challenge of protecting the client computers and denial of service attacks. Security experts can protect the servers and data transmissions can be protected through encryption. But how can a government ensure the security of a PC in your house? Given the level of viruses, hoaxes, and false statements on Web sites, it would seem to be relatively easy to attack millions of home computers to control an election.

On the other hand, society has an additional critical objective in designing a new voting system: the need to make it easier for people to vote to increase participation rates. To combat this problem, several states have implemented paper-based ballots shipped to each person's home. Ultimately the point is that no system is perfect, so the question quickly becomes whether an electronic vote system is better than the existing methods, and whether it is possible to prevent significant fraud. In a test of electronic voting systems in the Georgia 2001 election, almost all said the system was easy to use and over 94 percent said the entire state should move to the electronic system.

Reality Bytes: Movie Theaters v. DirecTV

Video is an interesting case in technology. Largely because of the bandwidth issue, video was one of the last entertainment categories to be digitized. It is also hugely expensive to create movies and entire business models evolved to handle the financing, production, and distribution of video, with many of the steps controlled by a few large firms. The one thing that most of the industry agrees on is that movies have a shelf life or immediacy. People will generally pay higher prices for newly released movies, but a considerable amount of back-end money exists for "older" movies that can be sold to a wider audience at lower prices. In 2011, DirectTV signed a deal with some studios that allows the satellite company to rent movies to customers for about $30—only two months after they debut at the theater. Traditionally, other offerings provided movies four months after release for a price of about $6. Theater owners and several directors (including James Cameron) expressed displeasure with the plan saying it was a "distribution model that cannibalizes theatrical ticket sales." Studios counter that most movies make their money within a couple weeks of release and that the need to make up revenue lost to declining DVD sales and changing consumer habits. But director Todd Phillips noted that "Knowing a film will be available at home so quickly removes the sense of urgency people feel to go see the film in theaters." Directors want to see the large screen and social atmosphere of theaters remain as the primary market for movies. Theater owners are concerned about going out of business. But, ultimately consumers will make the decisions on when they want to see movies and how much they are willing to pay.

Adapted from Michelle Kung and Ethan Smith, "Filmmakers Pan DirecTV Plan," *The Wall Street Journal*, April 21, 2011.

The issues of electronic voting systems are constantly debated in the press. Computer scientists state that even electronic voting booths can never be trusted, let alone voting over the Internet. Yet, many citizens actually would prefer the convenience of voting over the Internet, so there is pressure to develop a workable solution. Some interesting cryptographic methods exist that have the ability to make it possible. Securely implementing these technologies will take time, and require some interesting adaptations. One powerful trick (homomorphic encryption) is the ability to encrypt votes so that it is possible to record the vote total—without ever observing or decrypting the individual votes.

Information Warfare

As firms and entire economies become more dependent on information systems, the underlying infrastructure becomes critical to the nation. Think about how the information society will work in 10 years or so. Communication, including telephones, will be based on Internet protocols. B2B e-commerce will take place over the Internet, with automated agents placing orders and handling most transactions. Private and government services will be provided through Web sites. Web services will be offered through interlinked sites.

Now, imagine what happens if some nation or group decides to attack this information system. Inexperienced people using software scripts found on various Internet sites have already attacked individual companies. A few major attacks

Reality Bytes: China's State Internet Information Office

China has developed one of the strongest controls over the Internet of any nation. Particularly given the population and size of the Internet, managing and controlling policy can be a complex task. In 2011, China created a new central agency to handle all aspects of the Internet known as the State Internet Information Office. It is not clear how the many existing agencies will fit into the new organization, but it is in charge of "online content management," supervision of online gaming, video and publications, promotion of news sites, and government propaganda. The Office would also have the authority to investigate and punish people and companies who violate the rules. It will also be in charge of the telecommunications companies that provide Internet access. At least 14 other agencies have a hand in controlling the Internet in China, but the new office makes it clear that the Chinese government will continue to enforce limits on access to the Internet.

Adapted from Michael Wines, "China Establishes New Internet Regulator," *The New York Times*, May 4, 2011.

have been launched against the Internet DNS infrastructure. These denial-of-service attacks can be mounted by anyone. If an experienced, dedicated group of experts attacked a nation, they could stop service to huge segments of the economy. This threat is one aspect of the Internet that scares many agencies.

The United States and other national defense departments have begun planning for **information warfare (IW)**—in terms of both potential defenses and attacks. The ultimate objective of information warfare is to control the information available to the other side so that you can encourage them to take certain actions. This definition includes the ability to intercept communications, as well as to provide new data that will be accepted as valid. IW goes way beyond hacking into a system or destroying enemy computers and networks. In many ways, IW has been a part of war and conquest for centuries. The increasing use of computers, both in the military and in economies, has made IW more important. IW has existed in many respects from the early centuries of warfare. Some aspects became prominent in World War II, such as code breaking, the Navajo code talkers, the use of the BBC to send coded signals, and misinformation. Misinformation and control of the press (domestic and worldwide) have become key aspects to IW, particularly given the worldwide reach of CNN.

Some U.S. reports indicate that the Chinese military is attempting to develop viruses that can be inserted into foreign networks to disrupt the flow of data or provide false information. In 2010, an interesting virus "Stuxnet" was released on the world. Analysts who studied the virus determined that it was specifically targeted to attack Iranian nuclear facilities and was probably created by some government-funded agency (probably not in the U.S.). Some reports out of Iran indicated that it was successful in causing at least temporary problems at several facilities. Information attacks can be targeted against military or civilian objectives. Military uses of information warfare are common today. One of the first steps the U.S. air force takes is to disable the enemy's air defense systems to gain control over the enemy airspace.

Civilian attacks are still new, but the potential is huge. The military goal would be to destroy the economic ability of a nation to build and deploy weapons, but an

Reality Bytes: Google v. National India and Kazakhstan

As a leading Internet company, Google encounters many issues around the world. The company has taken the lead in many issues—trying to convince nations to remain open and allow everyone access to content on the Internet. In 2011, Indian regulators passed a set of rules that imposed restrictions on Internet content. Among other things, the regulations created by the Ministry of Communications and Information Technology require Web sites to remove objectionable content and to respond to government requests to remove content within 36 hours. Google was primarily concerned about being held liable for indexing content that was hosted by other sites. But a key issue in any Web site is whether the site is required to monitor posted content to look for possible violations of national laws. In the U.S. the laws do not require monitoring but do require some content to be removed when it is brought to the attention of the Web site publisher. In a more extreme situation, the Kazakhstan government in May 2011 ordered all Kazakh domains (a top-level domain of .kz) to route traffic only to servers in Kazakhstan. Kazakhstan is a former Soviet republic that is governed by a long-term president in an increasingly authoritarian regime. In response, Google suspended operations on its internal Kazakhstan servers and routed all search requests to the generic Google.com servers. Bill Coughran, a Senior Vice President at Google, noted that "We find ourselves in a difficult situation. Creating borders on the Web raises important questions for us, not only about network efficiency but also about user privacy and free expression."

Adapted from Amol Sharma, "Google Raised Objections to Draft India Internet Rules," *The Wall Street Journal*, May 10, 2011; and Alan Cullison, "Google Redirects Kazakhstan Traffic," *The Wall Street Journal*, June 8, 2011.

attack would also destroy the underlying infrastructure. The Internet was originally designed to survive military attacks through decentralization and the ability to route around broken links. However, as e-commerce has evolved, several vulnerabilities have been created that would enable governments or terrorists to disrupt major sections of the Internet by attacking some critical points.

In general, the same security controls that businesses use to protect systems on a daily basis are important to defend against international attacks. Ultimately, many aspects of the Internet infrastructure need to be improved to prevent attacks by terrorists, since the underlying components were not designed with security in mind. Several Internet committees are working on these new standards.

Rise of the World-State?

In ancient history (literally), communities of people formed into city-states to share common resources and provide a common defense. Because communication was limited and transportation costs were high, the city-states were largely self-sufficient. However, merchants traveled among cities to barter products that were only available in some locations. Over many years, transportation and communication costs declined, giving rise to nation-states. Through various battles and political arrangements, people accepted the role of the national governments, although some issues are still being fought.

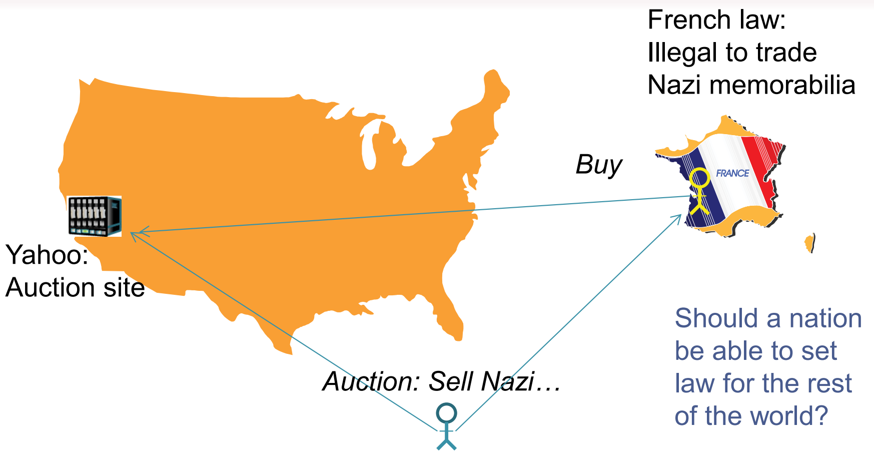


Figure 14.16

France v. Yahoo. France charged Yahoo with violating French law by allowing the sale of Nazi memorabilia online. A French court convicted and fined Yahoo, although Yahoo had no physical presence in France. A U.S. court later refused to grant France the ability to collect the money from Yahoo using U.S. courts.

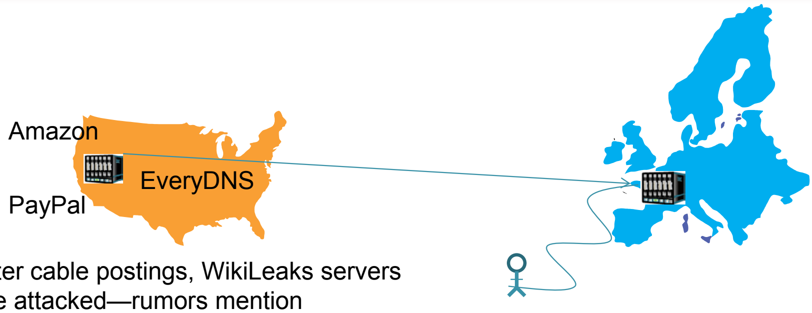
For years, many writers have suggested that increasing international trade, declining transportation costs, and improving global communication will eventually lead to a world-state. National governments might still exist, but commerce would be more regional and global, and world laws would be more important than national policies. The rise of the European Union and other free trade areas (such as NAFTA) are sometimes seen as forerunners of this world.

International e-commerce provides some support for this hypothesis. In an environment where digital data and services can be transferred instantly around the world, it is easy to see the irrelevance of individual national laws. With encryption and a wireless (satellite) connection, how can a national government impose rules or taxes on the digital transfer? If a serious digital monetary system is developed and accepted, how will a nation impose its independent economic policies? Some of these issues are being addressed today by global political organizations. Nations are slowly learning to cooperate and create common procedures and laws.

On the other hand, a world-state would be a massively complex system that would undoubtedly be politically unstable. There are still many regional tensions and periodic fights over physical resources. It would take many years of prosperity and economic growth before nations were willing to accept a truly global government. However, in the meantime, many issues will need to be negotiated in a global setting because they are beyond the control of any national government. Some international organizations facilitate these discussions, but most are somewhat cumbersome.

World Government Cases

Some of the issues in world governments are best seen through cases. Figure 14.16 shows one of the first major international cases. France has a national law that makes it illegal to trade (buy and sell) Nazi memorabilia. Based on their experiences in WWII, this law probably makes sense for France. Yahoo is a U.S.



1. After cable postings, WikiLeaks servers are attacked—rumors mention government.
2. WikiLeaks moved to Amazon servers for bandwidth and capacity.
3. Government officials contacted Amazon. Amazon kicked out WikiLeaks for violating terms of service.
4. Government officials contacted PayPal for taking donations. PayPal dropped WikiLeaks.
5. EveryDNS dropped registration for WikiLeaks.

Uploads to WikiLeaks

1. Video from Iraq on alleged U.S. abuses.
2. U.S. military documents on Iraq and Afghanistan wars.
3. U.S. diplomatic “cables” or State Department e-mails, many classified “secret.”

Figure 14.17

America v. WikiLeaks. WikiLeaks published several documents obtained from the U.S. government, including diplomatic cables marked “secret.” The U.S. government took several steps to harass or shut down WikiLeaks. Ultimately, WikiLeaks moved everything out of the U.S. and continues to run its servers at www.wikileaks.ch.

based company that started as one of the leading search engines. Yahoo also had an online auction system at one time. The problem is that anyone in the world could use the auction system, so someone might offer to sell or buy Nazi trinkets through the system—and conceivably, a French citizen might be the buyer or seller. France apparently asked Yahoo to block all trading in Nazi memorabilia, but Yahoo decided it was too hard or expensive to do that just for France. So, France prosecutors charged and tried Yahoo in French courts for violating their laws. Unsurprisingly, the French prosecutors won—the only surprise is that Yahoo bothered to show up. The courts imposed large fines on Yahoo. However, Yahoo had no physical facilities in France, and later, U.S. courts ruled that France had no authority to use American courts to extract the money from Yahoo. Of course, Yahoo would never be able to establish offices in France in the future without addressing the problems. The real issue of the case is whether one country can impose its laws on other nations, simply because they are connected through the Internet.

Now, consider the case of Microsoft v. Fujian Dongbai Group, which is a department store in China. Microsoft (and the Business Software Alliance) charged the company with violating copyright laws by using copies of Office and Windows on its computers to run its business. In April 2011, Microsoft prevailed and the Chinese company agreed to pay about $138,000 to Microsoft (see the *Wall Street Journal* note on April 21, 2011). How is this case different from the Yahoo case? The most important difference is that for several years, the U.S. government has diplomatically been pressuring nations, including China, to create

Reality Bytes: Cut Our Network and We'll Bomb You

In 2011, the Pentagon announced that some acts of cyberwar will be treated as any other type of attack on the United States. If electronic attacks on computers or the Internet cause death, damage, or high-level disruptions equivalent to a traditional military attack, then the U.S. will have grounds to treat the attack as an act of war and respond with use of force. Or, as an unidentified military official put it "If you shut down our power grid, maybe we will put a missile down one of your smokestacks." These new principles are based on the Pentagon's interpretation of the "Laws of Armed Conflict." The Pentagon still needs to determine which acts or levels would trigger a response and what level of response might be applicable to each case. And the bigger problem is going to be tracing the actual source of any attack. Still, nations need to begin thinking about and negotiating methods of identifying, stopping, and perhaps retaliating against cyber attacks.

Adapted from Siobhan Gorman and Julian E. Barnes, "Cyber Combat: Act of War," *The Wall Street Journal*, May 31, 2011.

intellectual property laws (including copyrights). China now has a copyright law, and Microsoft's case was presented to Chinese courts. So, can a country (the U.S.) impose its laws on other countries? Not directly, but perhaps it can convince others that the law is necessary and each nation can implement similar laws. This situation is a classic case of international cooperation and diplomacy. Over time, several laws have been presented for adoption around the world. Copyright is a big one, but computer crime laws including hacking and anti-terrorism are also important.

Figure 14.17 presents another recent case that is more ambiguous. WikiLeaks is a site and European company that is dedicated to publishing information provided by insiders to reveal corruption or other problems within organizations. In 2010, a person within the U.S. military (possibly Bradley Manning, a network technician), sent three major items to WikiLeaks: (1) Combat video from Iraq showing probable attacks by U.S. soldiers on civilians; (2) Classified government documents regarding the wars in Iraq and Afghanistan; and (3) Thousands of U.S. State Department diplomatic cables (e-mails), many of which were classified as "secret." This latter group of files appears to have angered President Obama and the U.S. State department. Although some of the documents were simultaneously published by traditional newspapers (such as *The Wall Street Journal*, *The Guardian*, and *El País*), most of the anger appeared to be directed at WikiLeaks. (See news accounts beginning in the Fall of 2010 for many details and rumors.) WikiLeaks quickly fell under attack from people trying to shut down the site with denial of service attacks. WikiLeaks claimed the attacks were coordinated by the U.S. government, but evidence has not been provided to support that claim. To handle the attacks by providing increased bandwidth and server capacity, WikiLeaks purchased space on Amazon's cloud system. Apparently, U.S. politicians contacted Amazon and asked that the site be removed. Amazon complied immediately—stating that WikiLeaks was in violation of the "terms of service" agreement. Another U.S. based company, EveryDNS, was the DNS registrar for the main WikiLeaks.org name. That company also dropped WikiLeaks as a customer, claiming that the DoS attacks were causing problems with their operations.

This step meant that no one could find WikiLeaks.org by entering just the name. WikiLeaks raised some of its money through donations to a German company that used PayPal to transfer funds. Again, it appears that American politicians pressured PayPal to drop the WikiLeaks company, and PayPal complied immediately. WikiLeaks still survives—in part because a Canadian company (EasyDNS) is handling the domain registration for the WikiLeaks.ch name. But, the case raises important questions about the role of governments in controlling various elements of the Internet. The WikiLeaks case is particularly interesting because it involves the U.S. government and a complete lack of due process or appeal. But, because the firms involved are individual companies, they are free to set their own policies. It is not clear what actions the U.S. government would have taken if companies such as Amazon or PayPal had declined to drop the WikiLeak sites.

Many subtler international and ethical issues exist across the Internet. For instance, China owns and controls all of the Internet routers in that country. It routinely blocks many sites and has the ability to track online activities of its citizens. As a sovereign nation, China is free to perform all of these tasks. But, some people have criticized American companies such as Google and Cisco for creating tools that enable China to implement these policies. The situation raises the question of whether companies should provide capabilities requested by large customers. A pure business approach would argue that anything that makes more money for the company is good. But, are there features or tools that companies should stay away from? The answer is probably "yes," but who makes these decisions? Do these decisions need to be made within individual firms, individual nations, or with the help of a global forum? The Internet is still young and many questions remain to be answered.

Crime

Do criminals know how to use computers? Crime has many aspects—both in the Internet/information world and in the "real" world. Security issues related to protecting information systems and Web sites are discussed in detail in Chapter 5. The issues in this chapter refer to questions of how governments can combat crime in society. Criminals today have access to the same technologies as everyone else. Drug dealers and weapons merchants use encrypted spreadsheets to track their sales. Terrorists use encrypted e-mail to transfer information. Con artists use the Internet to steal money from victims. Entirely new forms of harassment and stalking have been created with chat rooms, e-mail, cell phones, and other electronic communication systems. Most people want the government to protect them from these many forms of crime. The complication is that the electronic tools make it more difficult for police to work. So you as a citizen need to identify the trade-offs you are willing to accept.

Police Powers

For years, politicians have used the threat of crime to argue for granting increased powers to police agencies. Interception and decryption of communications (wiretapping) is a classic example. The United States passed the Communications Assistance for Law Enforcement Act (CALEA) in 1994. It has taken effect and requires that when requested by the government, any telecommunication company must route any communication that passes through its facilities to an off-site U.S. government facility. The FBI similarly created the Carnivore (DCS-10000) system to monitor and record all Internet communications of a targeted person.

Reality Bytes: Do Not Call, We Mean It

Spam, or unwanted commercial messages and phone calls are a global problem. And when most of the phones are mobile and people pay for minutes of usage, the calls are beyond annoying. Most nations have followed the lead of the U.S. and established do-not-call registries. The problem is that many, including the U.S., have minimal enforcement provisions. India, the number two country behind China, in terms of mobile phones learned the problem the hard way. Although a do-not-call registry was established in 2007, it was widely ignored—actually, the list was often used as a base list for calling. Until the Finance Minister Pranab Mukherjee received a telemarking call while in Parliament in 2010. A new law adds progressively higher fines on telemarketers, and requires commercial messages to be tagged with key numbers or headers. More importantly, the cell phone carriers will be responsible for increasing fines for each infraction; starting at $2,200 for the first offense and quacking increasing to $22,000 for the third or more offenses. Wireless carriers are complaining about the cost of installing hardware and software to comply with the law. And the largest provider, Bharti Airtel Ltd, announced it would stop providing text service to telemarketers.

Adapted from Megha Bahree, "India Adds Teeth to Do Not Call," *The Wall Street Journal*, June 20, 2011.

However, the FBI gave up on its technology and beginning in 2007 now requires all ISPs of any size to purchase and install equipment to collect and forward to a law enforcement agency all transmissions to or from a specific client. VoIP is the primary reason for the law, to enable law enforcement agencies to intercept phone calls placed over the Internet, but it also applies to data. In practice, if you run even a small wireless access point that gives public users access to the Internet, you must install technology to capture these transactions and forward them to the police on demand. On a global scale, the National Security Agency (NSA), in cooperation with other national partners, routinely captures and monitors international communications. Under federal mandate, wireless providers are phasing in locator systems designed to route emergency crews to callers who use cell phones. Of course, these same locator systems could be used by police to monitor the locations of suspected criminals.

Three questions must always be addressed with each new technology: (1) Is the technology effective or are there other ways to accomplish the same result? (2) How can society control the use of the technology and is it worth the loss of privacy? (3) Who is going to pay for the technology? The technology press contains many stories of abuses of power and information—including those by IRS agents and state and local police agencies. The police can also tell stories of how the criminals use modern technology to thwart investigations, and how additional police powers can be used to reduce crime.

Freedom of Speech

As constitutional scholars have long known, freedom of speech is a difficult concept. In practice, many limits are placed on individual speech to protect society. The classic example: you are not allowed to yell "Fire!" in a crowded theater (when there is no fire) because the result is dangerous to many people. Similarly, there are restrictions on "speech" on the Internet. A big element is that you cannot defame or harass others. While this statement seems obvious, what happens when people sign up with an anonymity server? They could then use free e-mail services, chat rooms, and Web sites to attack other people or companies.

The flip side of this situation is the issue of how to control these problems. Should a police agency have the ability to routinely break the anonymity server to identify all people? But that raises the question of what constitutes defamation and harassment? It is legal for a person to report truthful information about a company or an individual, but sometimes marginal in whistleblower situations. But what if the person being criticized is a public official and uses the police power to retaliate and harass the original person? Of course that action would be illegal as well, but how do you prevent it?

The main thing to remember is that there are many sides to all of these discussions. Also remember that many people have strong personal preferences on each side, and debates are often filled with emotional and unsubstantiated claims. In the coming years, these topics will become increasingly important. It is critical that you form an educated opinion and make sure that your voice is heard.

Gambling

Gambling on the Internet is a multibillion dollar, worldwide business. In many countries, gambling is routine and available at many locations. In the U.S., gambling is largely discouraged—except in some states or cities, and in cases where it is used to raise money for governments, and you can probably find a dozen other exceptions. The Federal Wire Act makes it illegal to gamble by wire. It was originally created to prevent gambling institutions from spreading through telephone and telegraph connections. Each state also has its own gambling laws, making it challenging to determine the status of gambling in any location. However, if it crosses a state line, the Federal law can be applied and enforced. In the early 2000s, the U.S. government used the law to effectively force basic gambling Web sites out of the United States. Of course, several international sites exist and provide gambling to anyone on the Internet. To prevent U.S. citizens from using these sites, The Unlawful Internet Gambling Enforcement Act of 2006 enabled the government to go after credit card companies and banks and prevent Americans from using credit card payments to gamble online. Consequently, it is difficult for Americans to gamble online because it is difficult to make payments and create accounts.

Partly due to the absence of general online gambling, and partly due to the televised national tournaments, online poker became a large business in the United States. At least until April 2011, when the U.S. government shut down several U.S. based poker sites, confiscated their bank accounts, took control of the domain names, and charged several owners of the sites with violating the Federal Wire Act (which includes jail time and monetary penalties if convicted). The initial defense by the owners was that poker is not gambling, but that argument could be difficult to win. However, even if the poker sites return, you should avoid them. By 2011, many poker-bots, or automated systems were capable of beating even the best human poker players. And, if the bots could coordinate their activities within one game, there would be no way to win against them.

The era of online poker playing is probably over. But, how long will it be before something else attempts to take its place? Does the U.S. need a better definition of gambling? Or, should gambling simply be expanded and opened up to any site?

Reality Bytes: Telecommuting Tax Problems

The old world rules that are dependent on physical location cause problems when they encounters new digital technologies. Telecommuting seems like a benefit to employees and businesses. Even for cities, telecommuting should be able to reduce the demands on services such as transportation, highways, and parking. But, as cities face losses in tax revenue, politicians become more creative in seeking ways to make money. In March 2010, the Tax Court of New Jersey ruled that TeleBright Software Corp., a company with its offices in Maryland, was actually "doing business" in New Jersey—simply because one of its employees lived in New Jersey and used telecommunication to work for the firm. Why does anyone care? Because if a company is declared to have a business presence in another state, it also has to pay income and sales taxes on any sales in that state. A survey conducted in April 2011 revealed that 35 states/regions (including D.C and New York City) said telecommuting would create a "nexus" allowing the state to impose income taxes on the company who employs that worker. In other cases, cities (particularly New York City) have declared that telecommuting means the worker is still subject to income taxes at the location of the company. So, a worker living in Kansas and working for a firm in NYC would have to pay income taxes to NYC (and Kansas).

Adapted from Barbara Haislip, "The Hidden Cost of Letting Workers Telecommute," *The Wall Street Journal*, June 13, 2011.

The evils of gambling are often espoused as a problem, but are U.S. citizens more susceptible to gambling addiction than other nations? Of course, online gambling could be a bigger problem for some people. Money lost online might not seem as real as money lost in hand. Again, these are questions that you have to answer as citizens through voting.

Responsibility and Ethics

How do your actions affect society? Is it possible to follow the laws and still be wrong? In any society, but particularly in one with open information, ethics and morality are important. Laws do not always keep up with changes in society. Think about small towns a century ago. A few basic laws existed, but people generally behaved responsibly, in part because if you gained a negative reputation, people would not trade with you. In an Internet world where people can write almost anything about you for others to find, it is possible that your reputation and honesty will become even more important. For example, eBay uses a ratings system to formalize these concepts. But even without worrying about your future prospects, you should strive to create an honest world.

Users

Computer users have certain responsibilities in terms of computer security and privacy. First, they have an obligation to obey the laws that pertain to computers. The U.S. government and some states, along with other nations, have laws against computer crimes. Most other traditional laws also apply to computer crimes. One law that has received much attention is the copyright law. European and U.S. copyright laws prohibit the copying of software, music, books, movies and other content except for necessary backup. It is the responsibility of users to keep up with the changes in the laws and to abide by them. In the last few years, publishers have increased their efforts to stop illegal copying of software, called **software piracy**.

Although it might seem to be trivial, making illegal copies of software (or videos, books, or other copyrighted works) can cause several problems. First, it takes money away from the legal owners of the software, which reduces their incentive to create new products. Second, you run the risk of hurting your employer. If employees illegally copy company-purchased software, the owners of the copyright can sue the employer. Third, copying software provides an illegal advantage over your competitors. A small design firm might decide to copy a $20,000 CAD design system instead of buying it. Consequently, honest firms are hurt because the original firm will be able to make lower bids on jobs because their costs are lower. Fourth, as an individual, you have a reputation to defend. If your friends, colleagues, or employers learn that you are willing to break the law by copying software, they can easily believe that you are willing to break other laws.

Users of computer systems also have an obligation as part of **computer ethics** to customers and clients. Most information in computer databases is confidential. It should not be revealed to anyone except authorized employees. Some nations have laws to protect this privacy. If you find a company violating these laws, it is your responsibility to question the practice.

Users have an obligation to use the information provided by computer applications appropriately. When a user sets up calculations in a spreadsheet, the user must realize that those calculations might be wrong. The calculations must be tested and the information produced should always be checked for reasonableness. You should not believe information solely because it comes from a computer. All data should be verified.

Programmers and Developers

Programmers would never get jobs if they could not be trusted. This trust is one of the most crucial requirements to being a programmer. As a programmer or developer, not only do you have to be honest, but you must also avoid any appearance of dishonesty. For example, practical jokes involving security violations can be dangerous to your career.

Programmers have more responsibilities than many other employees. Software is used in many critical areas. If a programmer attempts a job that is beyond his or her capabilities, crucial errors can be introduced. For example, consider what might happen if an underqualified person took a job programming medical life-support systems. If he or she made a mistake, a person might die. Although mistakes can be made by anyone, they are more likely to arise when a programmer attempts too difficult a job.

Along the same lines, programmers have an obligation to test everything they do. It also means that companies have the responsibility to provide adequate time for programmers to perform the tests. The important step is to identify components that are critical and to build in safeguards.

There have been enormous increases in the demand for software in the last decade. At the same time, new tools allow programmers to create much more complex applications. But our ability to create this new software has far outstripped our ability to ensure that it is error-free. Even commercial programs, such as word processors and spreadsheets, still have errors that can cause problems. In spite of the best efforts of conscientious, talented people, software used appropriately can produce erroneous information.

Liability for erroneous information produced by software has not been fully established yet. Laws and court decisions during the next few years should settle many aspects of who is responsible when software makes mistakes or fails. A related issue is the extent to which the user is responsible for correctly entering information needed by the program and for using the information produced by the program appropriately.

Companies

Every company has obligations to society, customers, employees, and business partners. In terms of society, a firm must obey all relevant laws. For customers, firms must ensure privacy of data. That means companies will collect only the data that they truly need. The data must be safeguarded so that only those who need it for their job have access. If customer information is sold or distributed for other purposes, customers should be notified. Consumers must be allowed to remove their names from any distribution lists.

For employees, a company must provide training and monitoring (compliance programs) to ensure they understand the laws and are following them. Firms must provide sufficient funds to allow the employees to meet their individual responsibilities. Companies must provide enough time and money to test software adequately. Firms have an obligation to allow their employees a certain amount of privacy. For instance, companies have no reason to routinely monitor and read employees' electronic mail messages.

Companies are required to abide by all partnership agreements. In terms of computers, they must safeguard all data acquired from partners. They must not use the data in a manner that would injure the firms involved.

Governments

Federal, state, and local governments have obligations to establish laws that provide a means for those unfairly injured to allow them to gain compensation from those who did the damage. Until the 1980s, relatively few laws at any level were specifically directed at computer usage. Instead, laws intended for other purposes were stretched to cover computer crimes. Frequently, citing mail fraud laws was the only recourse. Some criminals were not convicted because the crime was considered "victimless" by the jury, or the injured corporation declined to prosecute.

Starting in the mid-1980s, the federal government and nearly every state passed new laws concerning computer crime. In 1986, the Computer Fraud and Abuse Act and the Electronic Communications Privacy Act were enacted. The Computer Fraud and Abuse Act makes it a federal crime to alter, copy, view or damage data stored in computers subject to federal law. The law provides fines of up to $100,000 and up to 20 years in prison. The Computer Abuse Amendments Act of 1994 expanded the original definitions to include transmission of harmful code such as viruses. It distinguishes between actions taken "with reckless disregard" for potential damages (misdemeanor) and intentionally harmful acts (felony). It also modified the language so that crimes causing damages of more than $1,000 or involving medical records are within federal jurisdiction. Furthermore, it placed controls on states in terms of selling drivers' license records.

Most states have enacted similar laws for the few computers that might not be subject to federal law. European countries have been ahead of the United States in developing legislation to deal with computer crime.

In terms of enforcement, most federal, state, and local agencies have few, if any, officers devoted to solving computer crimes. In fact, many software piracy cases have been pursued by U.S. Secret Service agents. One complication is that most law enforcement agencies lack proper training in computer usage and investigation of computer crimes.

Some Computer-Related Laws

What major laws affect technology and the use of computers? Laws form the foundation of society. They provide the structure that enables businesses to exist. As society changes, the laws must also be changed. Hence, as the use of computers grows, we can expect to see more laws governing their use. Existing laws will be extended and new ones created. To date, computer laws have been concerned with three primary areas: property rights, privacy, and crime. These areas overlap, and they cannot cover all possible issues. As information technology and robotics become entwined into all our activities, virtually any law can be applied or interpreted to the situation.

Laws continually change and new interpretations and applications regularly arise. You will generally need a lawyer to help you understand and apply the current laws. This short appendix can provide you with only a limited background. You can find additional information in many places on the Web. This information will help you identify problems and generally enable you to obey the laws. However, a lawyer is still the best source of information—particularly if you anticipate problems or conflicts.

Property Rights

A property right gives you ownership and control over an object. While the term originated with physical property, the more important issues now involve intellectual property. If you write a book, a song, or a computer program, you should be able to receive money from sales of that item. Copyright, patent, trademark, and trade secret laws provide definitions of ownership and control transfer of these rights. They provide you with the opportunity to prevent others from using or stealing your work. Each of the four types of property-rights laws applies to different material.

Copyrights are used for books, songs, and computer software. The laws apply to the specific item, such as a book. You cannot copyright a general concept. For example, you can obtain a copyright for a specific word processing application. But other people are free to write similar applications, as long as they do not utilize your specific code or text. Copyrights generally last for 50 years after the death of the writer. In the case of a work produced by a group of workers in a company, the copyright lasts for 75 years after the publication of the work. After that time, the work falls into the public domain, where anyone can use or copy it with no restraints. The times vary by country and have been changed several times, so always check on current values.

Patents were originally designed for mechanical devices, although today you can receive a patent for any device that is innovative and useful. For many years, computer software applications could not receive patents because "laws of nature" including mathematical algorithms were specifically excluded. In the last few years, the U.S. Patent Office has changed this interpretation and now grants patents for computer software. A U.S. patent right exists for 20 years from the date the application was filed. The strength of a patent is that it prevents other people from creating a similar product, even if they do not directly copy your work. Consequently, a patent is much more difficult to obtain than a copyright.

Trademarks are used to create a unique name. Once you find and trademark a name (or logo), no one else can use that name without your permission. It is relatively easy to obtain a trademark, except that you must find a name that no one else has already chosen. You can begin your search at the U.S. Patent and Trademark Office: http:/www/uspto.gov.

Trade secret laws provide you with the ability to seek damages if someone steals your secret information. The catch is that you are responsible for protecting the information. The laws are generally used to enforce a **nondisclosure agreement (NDA)**. If a company wants to work with another company or a consultant, it is a good idea to have the outsiders sign an NDA, in which they agree not to reveal any information you share. If you forget to have them sign an NDA and they release your "secret" information, you will have few options. It is your responsibility to protect the data.

These four basic protections have different purposes and different strengths and weaknesses. Copyrights and trademarks are relatively easy and inexpensive to obtain. You simply fill out a form, submit the material, pay a fee, and wait a few months for the agency to process the request. Actually, a copyright exists as soon as you create the material. You do not need to file the registration form. However, there are some legal and monetary advantages to registering the copyright. Patents require considerable documentation and a formal review to identify prior and related patents and to determine the legitimacy of the innovation. They usually require the help of a specialized law firm, take at least a year to obtain, and will probably cost about $30,000 in legal and processing fees. Trade secret protection requires no registration with the government, but requires you to create and enforce a security policy to ensure that your information is adequately protected.

In a digital age, copyright law is the most challenging to apply and to enforce. The first question is identifying ownership. Who owns a particular item? If you write a book on your own time with your own resources, then generally you own the rights. If you write a computer program for your employer as part of your job, the employer owns the copyright. Interestingly, if you are an outside contractor and create a program for a company, it is more likely that you own the copyright, unless you agree to transfer the rights.

There is an interesting exception to copyright law: mere collections of data cannot be copyrighted. Consider the example of *Feist Publications v. Rural Telephone Service* [499 U.S. 340 (1991)]. Feist wanted to publish a telephone directory, but Rural would not provide the data. So Feist copied much of the data from Rural's printed directory. The U.S. Supreme Court eventually ruled that Feist's action was not a copyright infringement because the directory contained only data, which is not sufficiently original to obtain a copyright. Now consider the case of *ProCD, Inc. v. Zeidenberg* [86 F3d 1447 (7th Cir. 1996)]. ProCD collected and published a CD-based list of phone numbers and addresses, which they generally obtained from printed phone directories. Zeidenberg purchased a copy of the CDs and transferred them to his Web site. He then charged people to access the site. ProCD sued for violating the copyright laws. Based on the Feist case, Zeidenberg was found innocent of copyright infringement. However, he was guilty of violating the shrink-wrap license agreement that came with the CDs. Note that the data collection argument probably applies to most data collected by federal and state agencies.

Copyright protection gives you the ability to stop others from profiting from your work. There are a few minor exceptions—such as parody, excerpting short quotations, and educational "fair use," which allows educational institutions very limited provisions to make a limited number of copies for teaching purposes. A more interesting, unanticipated exception involves money. Consider the 1994 case of *U.S. v. LaMacchia*, who was a student running a bulletin board system on university computers. He routinely placed commercial software on the site and allowed people to download (steal) the software for their own use. The catch is that he did not charge access to the system and made no money from the process. Without this profit motive, the court ruled that LaMacchia could not be convicted on charges of criminal violation of the copyright laws. Of course, the commercial software vendors could sue him on civil grounds, but unless he was an unusually wealthy student, there would be little gain. On the other hand, the university could throw him out for violating university policy. Congress has modified the copyright provisions to cover this situation, so now anyone who violates copyright laws can be criminally charged, fined, and potentially jailed.

Copying becomes a more serious problem every day. As more works are created and distributed in digital form, it becomes more difficult to protect them. Even though you might have a legal right to prevent copying, it becomes increasingly difficult to prevent the distribution of your work, particularly if individual ethics are weak. For example, say that you write a story and sell it through your Web site. Once the first few people have read the story, they could copy it and e-mail it to their friends. What are you going to do? Arrest and sue your customers who first read the story? On the other hand, if a publisher took your story, printed it, and sold it, you clearly have the legal authority and monetary incentive to seek compensation. Consider a similar example. You build a Web site and create some interesting graphics and sound effects. Over time, other people routinely download your objects and use them on their own sites. Have they violated copyright laws? Can you stop them? Can you even find them? Would it be economically worthwhile to pursue them?

It is unlikely that individual motivations and ethics will improve. That is, despite the laws, many people will still copy anything they can (software, art, text, photos, video clips, and so on). Whatever technology might be applied, it is unlikely to be economically feasible to pursue them. Yet without incentive, why should you create and distribute new works? One possible outcome is that large, expensive content will disappear. Why should you write and distribute an entire book in one piece, when most people would steal it instead of paying $20 a copy? Instead, you could sell the book a section at a time, for a few cents per section. By releasing the sections over time, people would have to pay to receive the most recent (and organized) sections. Yes, some people might wait and have a friend pay for the section and e-mail it, but it is a question of economics. If the price is low enough, more people will opt to get the data earlier and directly from the source.

The federal white paper ("Intellectual Property and the National Information Infrastructure") contains an extended discussion of copyright issues and possible federal solutions. It is available online from the Information Infrastructure Task Force (IITF) Web site. You should also read Pamela Samuelson's criticism of the white paper proposal, which points out that the discussion strongly favors copyright holders as opposed to the public, particularly since the primary author (Bruce Lehman) was a lobbyist for the copyright industry.

- Freedom of Information Act
- Family Educational Rights and Privacy Act
- Fair Credit Reporting Act
- Privacy Act of 1974
- Privacy Protection Act of 1980
- Electronic Communications Privacy Act of 1986
- Video Privacy Act of 1988
- Driver's Privacy Protection Act of 1994
- Communications Assistance for Law Enforcement Act of 1994
- Health Insurance Portability and Accountability Act of 1996
- Children's Online Privacy Protection Act of 1998
- Identity Theft and Assumption Deterrence Act of 1998
- Graham-Leach-Bliley Act of 1999
- U.S. Patriot Act (antiterrorism) of 2001
- CAN-SPAM Act of 2003
- Fair and Accurate Credit Transactions Act of 2003 (FACTA)

Figure 14.18

Privacy laws. Only a few specialized laws exist to protect privacy in the United States. Some, like the Patriot Act, have actually removed earlier privacy protections.

Privacy

Privacy is an intriguing concept. Humans are a social group: we can accomplish far more by living in communities and sharing our talents. Yet individuals have a desire to keep some things private. More to the point, we have a desire to control what information we wish to share. For example, you might not want everyone to know exactly how old you are or how many times you were sick last year, but it is okay if your mother knows these things, and possibly essential that your doctor knows them.

Society has a vested interest in knowing some things about you and your life. For example, communities need to know how much you paid for your car and your house so they can fairly assess taxes. Society needs to track criminal behavior to help identify antisocial people who might harm others. Medical researchers need to track diseases to identify trends, causes, and potential solutions.

Businesses have an incentive to obtain considerable amounts of data on groups and individuals. And individuals have an incentive to provide some information to businesses. Whenever you make a purchase, you need information, and businesses are generally happy to provide you that information. The problem is how do you find the business or company that best matches your needs? Conversely, how can a company identify its potential customers? With no information, companies might resort to mass e-mail (spam) that clogs networks and irritates people who have no use for the services advertised.

The catch is that we do need to share information about ourselves, with government agencies, with researchers in various disciplines, and with businesses. Yet there is no reason that everyone in the world should be able to obtain every detail of our lives. The difficulty lies in determining where to draw this line. It is further complicated by the fact that every person (and social group) has different preferences.

First, it is important to realize that there is no constitutionally defined "right to privacy," especially with respect to data. A couple of Supreme Court rules have interpreted a right to privacy within the constitutional freedoms. But these rights apply only to governmental intrusion. A few laws have been enacted in the United States to provide minimal restrictions on the use and sharing of personal data. Figure 14.18 lists the most notable laws. Most are related to financial data and credit reporting agencies.

The Freedom of Information Act generally provides people with the ability to obtain information held by governmental agencies. There are limits for national security and on the release of data relating to individual personal data. For example, you cannot ask the IRS for personal information about your neighbor.

The most important feature of the Family Educational Rights and Privacy Act is that it limits the release of educational data. Institutions can release basic information such as the names of students (commonly sold to businesses), but they cannot release grades without the students' express written permission.

The primary purpose of the Electronic Communications Privacy Act was to extend traditional wiretap provisions to "electronic communication," which includes cellular phone and e-mail transmissions. Essentially, the law makes it illegal for individuals to intercept these conversations, and requires law enforcement agencies to obtain court permission to intercept and record the conversations. On the other hand, it is specifically legal for an individual to record his or her transmissions (although a few states limit this right). Consequently, employers generally have the legal right (since they own the equipment) to monitor most communications by employees. Note that there may be some exceptions and an honest employer will always notify employees first.

The Fair Credit Reporting Act primarily gives consumers the right to inspect credit records—and it gives them the right to correct errors. The Driver's Privacy Act limits the use and release of state motor vehicle data. Its primary purpose was to prevent release of specific data to individual requesters. However, it has generous exceptions for insurance companies, research, and business use. The Video Privacy Act was created to limit the release of rental records from video stores and libraries.

The Privacy Protection Act of 1980 is primarily concerned with law enforcement investigations. It provides some definitions for when police searches are legitimate and when they are an invasion of privacy. The act predates the advances in information technology, so it is generally silent on the issue of privacy in terms of electronic data.

On the other hand, the Privacy Act of 1974 deals more directly with the collection and dissemination of information by the federal government. It specifically limits the collection of data by an agency to information that is relevant to its work. It provides citizens with the ability to examine and contest the data. The act initially limited agencies from sharing and matching data with other agencies, but most of these restraints have been removed by subsequent amendments. For example, the postal service is generally not permitted to disclose data on individual addresses. However, it does release data to a few large commercial service bureaus. Companies can submit address lists to these bureaus for correction of their mailing lists.

The Communications Assistance for Law Enforcement Act (CALEA) requires telecommunications firms to pay for wiretap facilities for police to listen to conversations. In 2004, the FTC began discussions to expand the coverage to nontraditional communication providers, such as ISPs.

The Health Insurance Portability and Accountability Act (HIPAA) is used to limit sharing of medical information. Many health care organizations now ask you to sign forms that give them the authorization to share the data. Since it is unlikely that consumers have the ability to refuse to sign or modify these preprinted agreements, the overall effectiveness is minimal.

The Children's Online Privacy Protection Act is much stronger, and if you run a Web site, you need to be aware of its provisions. As long as you make it clear that you are collecting data only from adults, the law does not apply. However, if you do collect data from children, you must be careful to minimize the personal data collected and generally have to obtain "verifiable parental consent."

The 1998 Identity Theft and Assumption Deterrence Act prohibits "knowingly transfer[ring] or use[ing], without lawful authority, a means of identification of another person with the intent to commit, or to aid or abet, any unlawful activity that constitutes a violation of Federal law, or that constitutes a felony under any applicable State or local law." That is, it specifically makes identity-theft illegal, and targets the person who steals the identity, even if that person does not use the stolen identity.

The Graham-Leach-Bliley Act of 1999 primarily deregulated some financial services. In exchange, it imposed some trivial privacy clauses. In particular, it requires financial institutions to notify customers that they have the right to opt out of (1) selling their names to other companies and (2) marketing requests from the institution. Institutions reportedly spent hundreds of millions of dollars sending notices to customers, but many feel they deliberately made the process obscure and few consumers replied to the mass mailings. Consequently, businesses are basically free to continue using consumer data in any manner they want.

The U.S. Patriot Act was not directly concerned with privacy. However, it effectively repeals almost all governmental restraints. Someday it might result in some interesting lawsuits. One objective was to remove restraints to federal sharing of data.

The CAN-SPAM Act is a halfhearted attempt to reduce the fraud involved with most unsolicited commercial e-mail (spam). Although it is a relatively weak law, you need to make sure that your messages conform to its provisions. For example, you need to include a physical address in each unsolicited message. The message must state that it is an advertisement. You cannot include false return addresses or message headers. And you must provide a working opt-out system. It also imposes limits on how you collect e-mail addresses. Individuals cannot sue violators, but ISPs do have the authority to sue for substantial sums of money. The most powerful aspect of the law is that it applies to the sender of the message and to the firm being advertised. To be safe, if you send unsolicited e-mail messages, be sure to send them yourself from a verified list. Do not purchase lists, and do not use third parties to send messages on your behalf.

The Fair and Accurate Credit Transactions Act of 2003 (FACTA) primarily added definitions and a few features to the Fair Credit Reporting Act. A couple of useful points from the FACTA of 2003 is that credit agencies must provide free copies of credit reports to customers once a year (http://www.annualcreditreport.

com), and that merchant receipts cannot contain more than the last five digits of a customer's credit card number.

The bottom line is that this piecemeal approach to privacy means that it is difficult for consumers to determine their rights and for businesses to identify their responsibilities. Consequently, except for the few specific limitations (e.g., credit and educational records), most businesses are free to collect and share information. On the other hand, you can improve relationships with customers by always asking them for permission to use and share personal data. Keep in mind that states have their own laws that apply to transactions and companies within that state. For example, California prohibits merchants from requiring personal information from customers when they make a purchase. An interesting decision in 2011 pointed out that even asking for the customer's ZIP code—a common marketing practice—was in violation of the state law.

Information Era Crimes

As commerce moves to digital form, existing crime laws need to be extended and new ones need to be created. The biggest concerns are fraud, theft, and destruction of property. To understand the complications, consider what happens if someone steals your car. Why is that bad? Largely because you no longer have the use of the car. Now, what if someone steals your company's marketing plan? Why is that bad? You still have the use of the plan. Similarly, what if someone deleted your computerized customer database? Assuming that you are smart enough to keep a backup, what have you lost? The point of these questions is to show you that our traditional views on crime might not apply to crime related to information. Furthermore, computers create the prospect of new types of crime. For instance, what happens if someone writes a program that prevents you from obtaining access to your financial records? The alleged criminal did not steal or destroy anything, so what crime has been committed?

The Computer Fraud and Abuse Act of 1986 provides answers to many of the questions regarding crime in the digital realm. In particular, it outlaws (1) access to computers without authorization; (2) damage to computers, networks, data, and so on; (3) actions that lead to denial of service; and (4) interference with medical care. Interestingly, the act charged the U.S. Secret Service with enforcement.

Enforcement of the act has been challenging. It has been difficult to find qualified law enforcement personnel, including prosecutors. Besides, many businesses are reluctant to prosecute cases because they do not want competitors or shareholders to learn the details. On the other hand, sometimes companies and the Secret Service are too enthusiastic in their pursuit of alleged criminals. For example, one of the first cases supported by the Electronic Frontier Foundation (EFF) involved a (bulletin board system) BBS that supplied a document obtained from the telephone company that detailed information about the 911 system. The phone company complained that the document was stolen and that hackers might use it to break into its system. The Secret Service confiscated the BBS computer equipment and arrested the teenage owner. In court, with the help of the EFF, it was shown that the document could be purchased from the phone company for a few dollars.

Examining crime historically, the same problems exist in preventing more traditional crime and enforcing the laws. In the United States, it was the introduction of the FBI and their professional investigative techniques that improved the detection and enforcement of various crimes. In the digital arena, until society gains more experience and improved training of police, attorneys, and judges, it will face the same problems of weak laws, difficulty in prosecution, and variable enforcement.

The Digital Millennium Copyright Act (DMCA) of 1998 changed some copyright provisions to synchronize the U.S. laws with the European laws. It also included a unique controversial provision that makes it a federal crime to create or to distribute devices that circumvent copy protection schemes. Part of its original purpose was to prevent people from advertising and selling black boxes to decode scrambled satellite TV signals. Many people believe that these provisions are too strict and that they infringe on the free speech rights in the Constitution. For instance, some researchers have been threatened with prosecution under the DMCA if they attempted to publish their work. The problem with copyright laws is that they can provide only limited legal protection. To enforce these laws, a copyright holder generally has to prosecute violators. But as the record industry was aware in the Napster case, it is virtually impossible to find everyone who copies a song—even more impossible to take them all to court. So, property owners are searching for ways to prevent casual theft. The problem is that in theory, it is impossible to completely prevent the copying of a digital work. So, portions of the DMCA are required to make it difficult for people to sell circumvention technology. By making it more difficult for people to copy a work, the laws essentially raise the cost of stealing. But there are fine lines between protecting copyright holders, protecting consumers' rights to use a work, and protecting everyone's right to study new ideas. It will take time and discussion to draw these lines.

Driven by the September 11 attack on the World Trade Center in New York, the U.S.A. Patriot Act (antiterrorism bill) of 2001 provides considerable new powers to federal, state, and local police agencies. Some of these provisions reduce privacy by making it easier for police agencies to monitor conversations, intercept e-mail and Internet messages, and detain people without cause. Law enforcement agencies are asking for even more flexibility to investigate people. These provisions do have some justifiable uses, and there are times when enforcement agencies have to jump through too many hoops to perform their jobs effectively. However, as J. Edgar Hoover proved, the challenge lies in preventing abuse of the laws, particularly preventing people from using them as political tools.

Cloud Computing

What risks are created through using cloud computing? Cloud computing raises some interesting questions—particularly from a legal perspective. A private cloud—owned and operated by your own company in one or two locations is less of an issue. As long as you control the location and operation of the servers, a private cloud is no different from any other set of servers. The problems begin to arise with public clouds—when you rent processors and data storage space on servers run by other companies. Three basic problems arise with storing data and processing public clouds: (1) Data is transferred across multiple national boundaries and subject to laws in multiple nations; (2) Shared servers might be at risk if police confiscate or search the computers because of a second company, or if attackers initiate a denial of service attack against another company on the server; (3) With multiple levels of contractors and subcontractors, you must ensure everyone respects the security and privacy of your data.

Figure 14.19

National location issues in the cloud. If your data is transferred across multiple borders and stored in multiple countries. What national rules need to be followed? What countries might seek to control or limit your use of the data?

Data in Multiple Countries

Figure 14.19 shows the first issue. One of the strengths of cloud computing is that multiple servers in different locations are used to hold the data—both as backup and to provide faster access across the world. These are useful technical attributes. But, from society's perspective, the data is crossing multiple boundaries and is potentially subject to laws in multiple nations. For instance, what if some of the customer data is transferred to servers in Europe? Does that data become subject to European privacy laws—which are much stricter than those in the United States? But, do you even know where the data is currently stored? What if you are storing data that is politically sensitive? Can one nation confiscate or block your data?

These questions are not hypothetical. In 2010, the Web site WikiLeaks (not a U.S. company) began releasing data that it obtained from sensitive U.S. diplomatic e-mails. The U.S. government was unhappy about the release of the data—which they claimed was stolen (and then given to WikiLeaks). At one point, the WikiLeaks servers were subjected to a distributed denial of service attack and they struggled to remain online. The company paid Amazon to host their content on the Amazon cloud servers—with the hope that the huge bandwidth and distributed service would mitigate the effect of the attacks. Technically, the process worked. But, high-level politicians in the U.S. government contacted Amazon (a U.S. company) and urged them to stop hosting WikiLeaks content. Amazon complied and removed the content. The U.S. government also pressured the U.S. company that was providing DNS services to WikiLeaks and told them to drop the listing—so no one could go directly to the Web site. The WikiLeaks site is currently available through a Swiss registration: www.wikileaks.ch. (This information is available in many news reports from late 2010 and early 2011.) Regardless of which side you might take in the WikiLeaks discussion, the business point is that national gov-

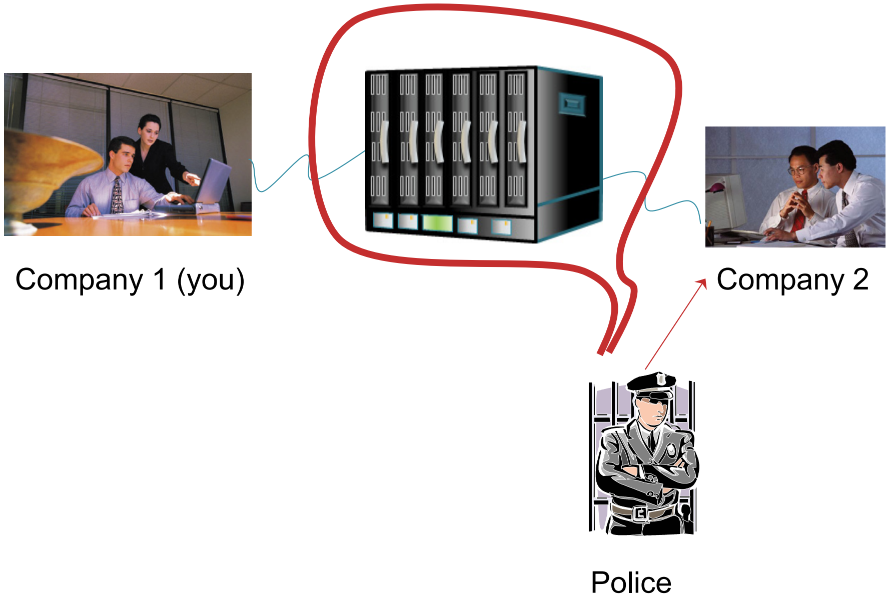


Figure 14.20

Complications with shared servers. When police investigate a second company, they might collect all of the data on a server or even confiscate the physical server. These actions might include your innocent data and disrupt your services. Similarly, if attackers flood a company's site, it might knock down your site as well.

ernments can exert huge control over cloud service providers—depending on the location. Political, security, and tax issues could vary depending on the location of your data. So, you might have to write contracts to control exactly where the cloud provider will store your data. However, in a related situation, Research in Motion, the Canadian company that sells the Blackberry cell phone and service encountered problems in 2010 and 2011. Several nations insisted that the company run e-mail servers within their countries—so national investigators could confiscate or tap the servers if necessary to control communications by citizens within their countries.

If you want some idea of government involvement or interference in the Internet, check out Google's statistics (http://www.google.com/transparencyreport/governmentrequests/). Interestingly, the United States and Brazil are at the top of the list for countries asking Google for data and for requests to remove links. In 2011, Freedom House also examined national limits placed on Web traffic and digital media (Sanja Kelly and Sarah Cook, Freedom on the Net 2011).

Threats to Shared Servers

As shown in Figure 14.20, a second potential problem with cloud computing is that the servers and Internet connections are ultimately shared with other companies. The cloud provider makes money by building huge server farms and then leasing out capacity to many customers. In many cases, the companies lease virtual machines, and any physical server can run many virtual machines.

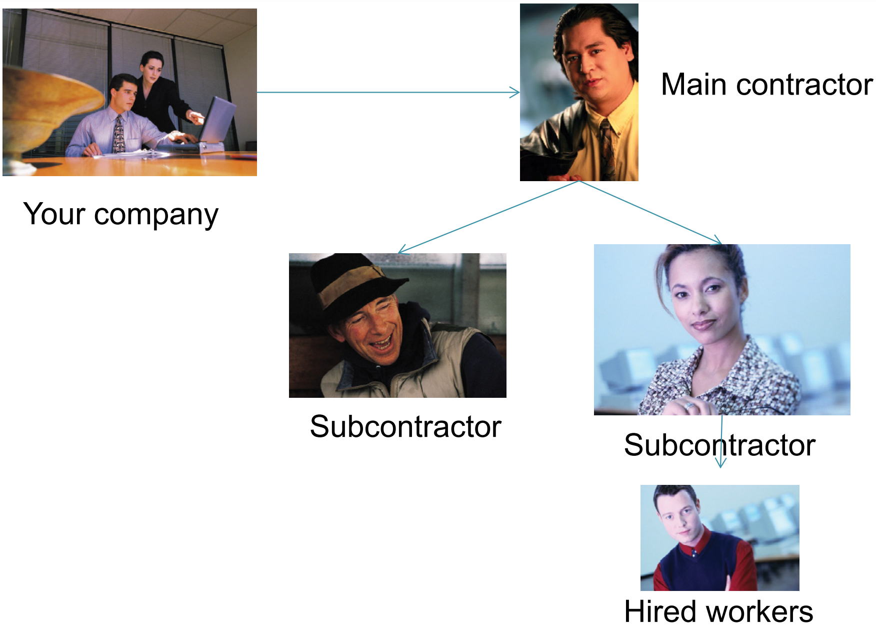


Figure 14.21

Controlling subcontractors. You can sign a detailed contract with a cloud provider, but that company might subcontract services to several companies in different countries. Workers at many levels might have access to servers that host your data.

The problem with sharing the physical machine is that it is not always easy to separate the companies. At least a few cases have already arisen where police investigators have confiscated entire physical servers to gather evidence against a company using the server. The problem is that taking down the entire server affects other companies. Even if the police only need to collect data, they are likely to collect all of the data—including yours. Similarly, an attacker or group of people might become upset at a particular company and launch a denial of service attack against that company. If that company uses the same cloud service as you do, it is likely that your server and Internet connection will be disrupted as well. Stronger cloud providers like Amazon might have enough bandwidth and server capacity to handle the increased load, but it is still a potential risk.

Subcontractors

Figure 14.21 shows a more subtle problem with cloud computing services. When you sign a contract with a cloud service provider, you deal with the top level, but many sublevels can exist below that one. For example, it is possible that each server location is run by a separate contractor. Employees from several contractors might have access to the servers, and ultimately the data, at any location. For instance, network and security specialists, database administrators, and server operators might all be hired by different companies. Throw in electricians, cleaning companies, and security guards and multiply by the number of countries where the servers are located. Potentially dozens of companies might have access to the physical computers and data in different locations. Hopefully, all of them are trained and honest and know how to protect your data. But, what if you are required to guarantee that the data is accurate and protected? For example, you might want to store employee or healthcare data. Realistically, can you meet that guarantee when you do not know all of the levels of people who might have access? Encryption might help, but only if the encryption keys and all decryption are handled by local servers.

For most cases, it is possible to handle these three types of problems, so they are not intended to suggest cloud computing should be avoided. Cloud computing can provide some significant benefits. But, you need to be aware of these potential problems before you commit to a cloud service provider so you can ask the right questions.

Summary

Technological change and increasingly aggressive use of information systems by businesses have several consequences. Technology affects individuals, their jobs, educational systems, governments, and society as a whole. Businesses have to be careful to protect the privacy of consumers and workers. Security provisions, disclosure policies, and audits are used to ensure that data is used only for authorized purposes. To ensure accuracy, it is crucial to allow customers (and workers) to examine relevant data and make changes.

Technology is generally believed to increase the total number of jobs available. However, the workers displaced by the introduction of technology are rarely qualified for the new jobs. Businesses and governments need to provide retraining and relocation to help those workers who lose their jobs. Sometimes technology allows physically disabled people to work in jobs they might not otherwise be able to perform.

Improved communication networks, huge databases, and multimedia tools provide possibilities for education and training in the public and business sectors. However, because of high development costs, technology tends to be used for specialized training.

Governments have long been involved in data collection, and technology enables them to work more efficiently. Of course, many political observers would argue that perhaps governments should not be *too* efficient. For example, it would be difficult for businesses to operate in an environment where the laws were changed every day. Technology also has the potential to improve communication between citizens and their representatives.

Technology and society produce other interactions. One feature is that lower prices, improved capabilities, and ease of use have made improved communication available to virtually any size group—providing a wider audience for small extremist groups. The new technologies also offer the ability to alter pictures, sound, and video, making it difficult to determine the difference between fact and fiction. Another important social issue is providing access to technology for everyone. It would be easy to create a world or nation consisting of *haves* and *have-nots* in terms of access to information. Those with information would be able to grow and earn more money, while those lacking the data continually lose ground.

Increasing dependence on technology brings with it new threats to the security of the firm. Managers need to recognize and evaluate these threats and understand some of the techniques used to minimize them. The most common threats come from inside the company, in terms of workers, consultants, and business partnerships. These threats are difficult to control, because firms have to trust these individuals to do their jobs. Training, oversight, audits, and separation of duties are common means to minimize threats. Depending on the communication systems used, there are threats from outsiders and viruses that can access computers with modems, over networks, or by intercepting communications. Dial-back modems, access controls, encryption, and antivirus software are common techniques to combat these threats.

Working in today's business environment means more than just doing your job. Each individual and firm has ethical obligations to consumers, workers, other companies, and society. In addition to obeying the laws, it is important for workers and companies to remember that the data in information systems refers to real people. The lives of people can be adversely affected by inaccurate data, poorly designed information systems, or abuse of the information.

A Manager's View

As a manager, you need to understand how businesses, technology, and society interact. Dealing with changes in privacy and security threats will become increasingly important to managing a company. Evaluating changes in society will also give you an advantage in the marketplace; it is important to know your customers. As a citizen, you need to be aware of the negative and positive effects of technology. In particular, changes in technology often lead to changes in political power and control. As a manager and a citizen, you are obligated to make ethical decisions and to understand the consequences of your actions.

Key Words

computer ethics
cookies
copyright
digital divide
digital rights management (DRM)
high-bandwidth digital content protection (HDCP)
information warfare (IW)
intellectual property (IP)
nondisclosure agreement (NDA)
patent
privacy
software piracy

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Internet Society	www.isoc.org
Privacy	
Electronic Frontier Foundation	www.eff.com
Electronic Privacy Information Center	www.epic.org
FTC advisory committee	www.ftc.gov/acoas
FTC privacy and security	business.ftc.gov/privacy-and-security
Platform for privacy preferences	www.w3.org/P3P
Privacy, ACM	www.acm.org/usacm/privacy
Privacy International	www.privacyinternational.org
Privacy Rights	www.privacyrights.org

Review Questions

1. Do employees need to worry about the data collected by their employers?
2. If everyone is identified by some biometric measure, will that cause more dehumanization? Will it reduce individual privacy?
3. Do you think increasing use of computers causes a loss of jobs? What about in the past or in the future?
4. What are the personal benefits to telecommuting? Why would people choose to return to commuting jobs after trying telecommuting?
5. Do computers and digital content change the balance of power relationship between consumers and businesses? Should consumers have a right to make personal (backup) copies of digital works?
6. How does information technology add legitimacy to fringe groups?
7. Do you think state, local, and federal governments are making efficient use of computers? Will citizens ever be able to vote online?
8. In what ways have computers affected society and organizations? Will these patterns continue? Are there other important patterns that might arise?
9. Should governments be granted more powers to monitor and investigate people and transactions on the Internet?
10. What are the ethical responsibilities of users in terms of information systems?

11. Do we need additional privacy laws in the United States? What provisions would you add?
12. As a business manager running a Web-based company, which laws and rules do you need to pay careful attention to?
13. What is information warfare and what controls or oversight should be placed on it?
14. List the primary U.S. laws related to computer crime and describe each in one sentence.
15. If data is stored in an international Web cloud, what potential problems exist for companies? Do we need new world laws to cover these situations?
16. If you write a blog and publish it on a Web site, who owns it? Can other users copy it? What if you are paid by your company to write the blog?
17. Should governments have teams to create computer viruses that can be sent to other countries?

Exercises

1. Research the tools (hardware and software) available for a new employee of yours who is blind. List the sources, capabilities, and costs.
2. Should people be allowed to use the Internet anonymously? Should ISPs be required to pay for hardware and software that can track individual usage in case of a lawsuit or criminal charge? Is it possible to prevent anonymous use of the Internet?
3. Do you think governmental agencies should share data about citizens? For example, should the FBI be able to access IRS records to locate suspected criminals? Should the FBI be allowed to access files from state and local governments? For instance, should all arrest records be automatically relayed to a central database? Should medical records be accessible to law enforcement agencies? Say that it is technically possible for the FBI to build a national database that contains DNA records for all citizens. If all medical records (from accidents, blood tests, and medical treatment) were computerized and automatically forwarded to the FBI, the agents could easily locate virtually any criminal.
4. Some remaining Federal laws limit the ability to create huge, integrated collections of personal data. Some agencies, including the FBI, have turned to buying this data from private companies (e.g., ChoicePoint). Should government agencies be allowed to circumvent laws by purchasing data on individuals from private agencies?
5. Research the issues involved in electronic voting. What problems need to be overcome? What technologies could be useful? Does an electronic voting system have to be perfect, or simply better than the existing manual system?
6. Should vendors be allowed to charge different prices for online products, or should everyone pay the same price? Answer the question both from the perspective of the consumer and as a vendor or artist.

7. Should consumers be able to sue software companies for security failures or other problems with the software? What limits these lawsuits now?

8. What aspects of education would you prefer to have online or automated? What elements would you prefer to keep in person?

9. Find at least five news sites on the Web. Evaluate them in terms of (1) style/presentation, (2) accuracy, (3) believability, and (4) balanced news.

10. Identify which privacy and computer crime laws might apply to the following situations:

    a. Someone intentionally downloads a program from a Web site which is then used to run a denial of service attack on government computers.
    b. A hospital employee sells a celebrity's health report to a newspaper.
    c. You download and distribute copies to your friends of a software program that captures digital video and audio streams and converts them to unprotected files.
    d. A Chinese government agent intercepts your PayPal data and uses it to buy electronics items.
    e. Homeland Security asks your ISP to provide copies of all of your Skype conversations.
    f. You send marketing e-mail to customers without including your business address.

11. Should Internet gambling be legal in the United States?

12. Should all consumers be allowed to pay the same price for identical items purchased on the Web?

Technology Toolbox

13. Find at least two translation sites and test them with sample text. If you read the second language, comment on the results. Translate the text back to the original language and comment on the quality.

14. Find at least two foreign exchange sites and convert $100 (USD) into a different currency. How much does your credit card company charge for currency exchanges?

15. Why would you not want to use "Private" or "Incognito" browsing all the time?

16. Research the current status of the "do not track" option to see if there is any progress towards it becoming a standard.

17. Even with cookies blocked and "Private" browsing, explain how your Internet activities can still be tracked.

Teamwork

18. Assume that you are selling a new release for popular music. Create a silent auction and have everyone write down the price they are willing to pay for the music. Add up the numbers to get the total revenue you would obtain. Now, look up an average price for a similar item. Assume that each person who was willing to pay at least that amount would actually buy the item, and the others would not. Count the number of items sold and multiply by the fixed average price to get revenue. Compare the two values for total revenue.
19. Have each team member select a developing nation. Research the information technology available in that country. How do people get access to the Internet? What percentage of the people have used the Internet? Combine the results and create a list of options that might be used by other nations to improve Internet access.
20. Split the team into two groups to participate in a debate. The proposition is that programmers and developers should be licensed. One group should find evidence and arguments to support the proposition, the other to defeat it. If possible, conduct an actual debate. Otherwise, outline your arguments and compare them in writing.
21. Examine the arguments against electronic voting. Divide the arguments among the team members and have each person research existing technologies and proposals. Identify the methods used to avoid or minimize the stated problem. Combine the results and write a proposal defending the use of electronic voting.
22. Interview or survey at least 30 people, not students in the class and be sure to include a range of demographics including older people. Ask them what they would think about a national ID number and how it might affect them. Ask them what they think about the potential benefits and how it would be different from the existing system.
23. Split the team into three groups and have each group choose one nation. Find at least one computer-crime or privacy law for that country. Note: It helps if at least one person in the group can read Web documents in the country's language. Combine the results and summarize which crimes are most commonly outlawed.
24. Research a couple of current patent violation cases involving IT and argue why patent laws and procedures should be changed.

Rolling Thunder Database

25. What privacy problems might exist at Rolling Thunder? What rules or procedures should be enacted to avoid problems?
26. Your boss says that with the decline in sales, it would be wise to cut costs and suggests that you could buy only a single copy of some of the office software and install it on multiple machines. What do you do?

27. The management at Rolling Thunder is thinking about trying to get a patent for an online process of configuring and ordering a custom bicycle. Search the patent records to see if anyone already has a similar patent, and estimate the probability of obtaining such a patent.

28. Rolling Thunder Bicycles wants to begin sales to Europe. It is currently run completely in the United States. The company will add a Web site and establish separate contacts with bike stores in Europe. What effect will these actions have on the information system?

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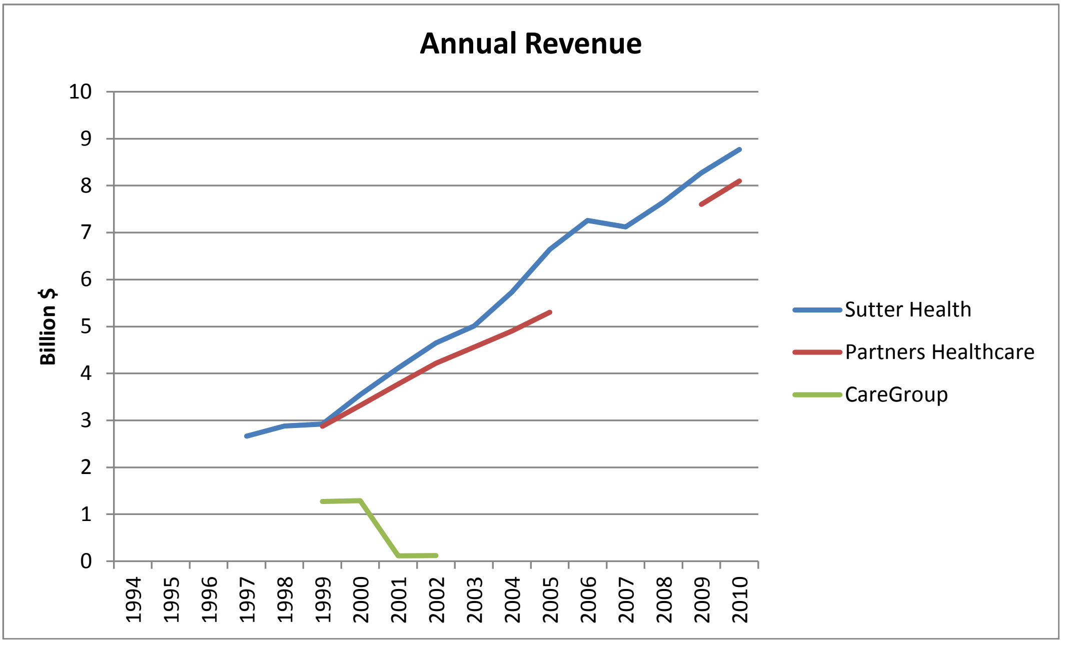
Cases: Health Care

The Industry



Health care makes up a substantial portion of expenditures in the United States. In 2004, health care expenditures were projected to be $1.8 trillion, a whopping 15.3 percent of gross domestic product. As the population ages, particularly the boomers, the U.S. government estimates that these values will rise to $3.4 trillion or 18.4 percent of GDP by 2013 (Brewin 2004). It is also a highly complex industry because the ultimate consumer, the patient, rarely bears the direct costs of the services. In 2000 (the most recent federal study), private medical insurance covered about 41 percent of total health care expenses, Medicare and Medicaid combined paid about 31 percent, and individuals paid 19 percent of the costs out of their own pockets (AHRQ 2003). The Census Bureau maintains a history of health expenditures and annually updates the projections. The 2008 actual data were $2.3 trillion (16.2 percent of GDP), with a projection for 2015 of $3.4 trillion. The tables also separate private and public expenditures and breakdowns for hospitalization, physician, drug, and nursing home costs (http://www.census.gov/compendia/statab/cats/health_nutrition/health_expenditures.html, Table 130). In 2008, about 53 percent of the costs were paid by private funds, 35 percent federal, and12 percent state. Almost 12 percent of the costs were paid out of pocket by individuals, versus private insurance.

Federal Involvement in Care

Some people have heard about mistakes made in operating rooms—where the surgeon operated on the wrong knee or arm. Some patients have taken to writing on their limbs before surgery—just to make sure everyone knows which leg or arm to work on. Not as many people are aware of the problems that arise with drugs.

Physicians sometimes prescribe the wrong drug. Nurses occasionally deliver the wrong drug or incorrect dose to a patient. The federal government has stepped in to reduce this problem. The Food and Drug Administration (FDA) in 2003 issued a ruling to take effect in 2004 for new drugs and 2006 for existing drugs. All individual doses of drugs will be required to have bar codes. Hospitals will then have to implement bedside bar code readers that match patients and drugs before giving the drugs. Any errors will be flagged by the system. Hospitals are spending millions of dollars to add the new systems. In terms of those surgeries, new rulings require hospitals and physicians to adopt a marking system and mark every operating site on the body while the patient is conscious, to reduce mistakes. Apparently, they could not figure out a way to bar code the body parts.

In 2004, President George Bush stated that he wanted the entire health care system to move to electronic records. Within 10 years, hospitals are supposed to have a system that allows electronic sharing of medical data (Brewin 2004). This push goes far beyond individual hospitals. It means that the entire health care and health informatics industry has to agree on standards and has to come up with a way to identify patients and transfer data securely.

The industry has been trying for several years to devise a health care information system that would work for the entire industry. Tommy Thompson, U.S. Secretary of Health and Human Services, had asked the industry to derive a blueprint for an electronic health-record system. In late 2003, the initial plan was rejected by the industry because it was overly complex. The original design was cumbersome, yet still did not address all of the potential issues. Part of the problem is that it tried to focus on a detailed level and include everything from medical records to billing to patient history. A bigger problem is that several proprietary systems already exist, and vendors are concerned that a government-designated system would be incompatible. At this point, there is not even a framework or structure for defining the overall approach (Landro, 2003).

The federal government has also taken an interest in improving health care by reducing errors through bad information. Panni Kanyuk, a senior Datamonitor health-care analyst noted that "information technology is an important tool in improving patient quality of care, and we're seeing this resonate in the market." Most health-care providers surveyed responded that they anticipated increasing IT spending by at least 10 percent per year (McGee 2004).

Several medical care providers have adopted electronic systems for recording physician drug orders. The systems have the ability to reduce errors and improve communication. However, they still require physicians, pharmacists, and patients to be conscientious and observant. A study at one hospital identify 22 ways that medication errors were facilitated by a computerized physician order entry system. Although handwriting errors are no longer an issue, other problems can arise with information errors and usability problems. Ross Koppel of the Center for Clinical Epidemiology and Biostatistics at the University Pennsylvania School of Medicine observed "the largest problem is that the system asks house staff to twist the software like a pretzel rather than the software corresponding to the way the work is done" (McGee 2005).

Information technology has the potential to manage data and reduce costs and time, but the medical world is highly fragmented. Many physicians work in their own offices, and hospitals are often independent or connected into loose networks. Throw in a few dozen insurance companies, and various state and federal organizations, and even simple communication becomes challenging. A study by a researcher at Sutter Health in California found that even with HER systems, physician costs are high because of the problems dealing with multiple health plans. Annual costs for even a small clinical practice were estimated to be $51,221 for non-clinical personnel time and $34,052 for physician time—for each physician in the clinic. The total costs of $85,273 represented 10 percent of total revenue for a practice (Hardy 2009).

Privacy

Privacy has become a more important issue. The Health Insurance Portability and Accountability Act of 1996 (HIPAA) has finally been given some teeth. Any organization that handles medical data has to comply with rules that prevent them from releasing medical data. The rules cover accidental releases, such as overheard conversations, and security breaches.

Actually, President Bush watered down the original medical privacy rules created by President Bill Clinton. The original rules required mandatory patient consent to disclose data, even for treatment and payment. The new rules simply require that patients be notified of the privacy policies (CNN Online 2002). The main argument was that getting patient signatures might slow down the treatment process. Although privacy advocates were upset, the real-world effect was probably minimal. Most health care providers were simply requiring patients to sign a form that waives most privacy anyway.

The law has been useful at encouraging health care providers to tighten up the access to medical records. For example, hospitals cannot release or use patient data for charity solicitations. The billing system has to be separate from the medical system, so that a billing clerk could see that a patient was billed for a test but not see the test results (Tarkan 2003).

In 2010, the U.S. Congress passed a healthcare law that was not exactly popular—it was challenged in court on several grounds, and will probably eventually end up before the U.S. Supreme Court, or be overwritten when Obama leaves office. The law is known as the Patient Protection and Affordable Care Act. One of its main, and controversial, elements is that it requires everyone to buy health insurance. One of the problems often cited by reform proponents is that uninsured people cost the system billions of dollars a year because hospitals and doctors are ethically required to treat sick and injured people even if they have no insurance. And people with no insurance tend to avoid paying for routine car and wait until they have to go to the emergency rooms. The goal of the law was to help reduce the projected federal deficit due to rising Medicare and Medicaid costs (Moore 2011). Although, it is difficult to see how costs can be reduced without deliberate increases in supply.

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Case: Sutter Health

Sutter Health is one of the largest health care systems in northern California. In 2002, the not-for-profit organization had almost 40,000 employees and patient services revenues of almost $4 billion. Its 26-member hospitals with 5,773 beds recorded almost 240,000 discharges in 2002 and over 2.5 million outpatient visits (www.sutterhealth.com). Like any hospital group, Sutter works to improve the health of its community. And it struggles to balance costs, medical technologies, and information technology.

Quality Care

Sutter is working to build the new systems to implement the FDA drug bar code rules and improve the quality of drug prescriptions. It is deploying 6,000 PCs on mobile carts. They will be connected by Wi-Fi wireless networks because it would be too expensive to install wires in every hospital (Cuneo 2004). One advantage to the new system is that drug manufacturers will be required to put bar codes on individual doses. They have used them on bulk shipments in the past, but that still required hospitals to repackage and remark all of the drugs. John Hummel, CIO of Sutter Health, observed that those codes will save the company about $2 million a year (Brewin 2004).

Sutter recognized that a key part of the bar code point-of-care (BPOC) technology is that it had to be combined with a computerized physician order entry (CPOE) system. When the nurse scans patient and drug codes, the system has to verify the original drug order. That means the physicians need to enter the drug orders electronically. Sutter chose to implement a high-end BPOC system that also checks for patient allergies and asks nurses to double-check drugs if they have similar names or similar appearance to other drugs. Hummel involved nurses early in the selection process to ensure the system would be easy to use and that they would willingly adopt it. After implementation, nurses indicated a 42 percent improvement in satisfaction and a 64 percent improvement in perception of system efficiency (Johnson et al. 2004). Furthermore, the real-time dispensing data feeds directly into the charging system, so patient bills are more accurate.

One of the early challenges that Hummel faced was the need to integrate data from multiple medical systems. In 1999, he installed an interface engine from

Century Analysis, now a division of Sybase. It serves as a hub and transfers data across systems. For example, the data from the Siemens Medical Health Services that handles picture archives can be transferred to or accessed from the Lawson ERP system. In 2003, he upgraded the engine to an eGate intregration platform from SeeBeyond Technology Corporation. The new system utilizes XML to transfer data quickly between even more systems. His ultimate goal is to provide a single view of all patient data. The company is using Identity Hub software, an artificial-intelligence tool from Initiate Systems, that uses statistical techniques to match historical data. It is critical that physicians accurately identify patients to retrieve the proper records. Hummel observes that "if I go to the doctor, he needs to know the difference between John Hummel and John C. Hummel" (McGee September 2003).

As of 2004, more than 1,000 Sutter physicians store patient data electronically, and more than 400 of them have totally paperless offices. Even X-rays and prescriptions are stored digitally. The goal is to have data for all 4.5 million Sutter patients integrated in 2006. The system will make it easier for patients and physicians to use the health services—regardless of location.

Hummel's group is also building a virtual intensive care unit (ICU), where each hospital will have telecommunication links with real-time videoconferencing to an ICU physician. The ICU staff will be able to remotely monitor patients and collaborate with on-site staff. With the eICU system, one ICU physician and nurse monitor dozens of patients at hospitals that cannot afford full-time intensive care units. Keeping a physician online full-time provides additional supervision. Nurses do not have to worry about finding a doctor or surgeon for unnecessary cases. Dr. Daniel Ikeda, director of the system, notes that "when I'm in the eICU, I'm a lifeguard. I use the technology to look for troubling trends, before they become serious complications. A critically ill patient can turn sour in a matter of minutes. (Kolbasuk 2003).

The electronic ICU has been successful, based on its ability to prevent deaths and on the increasing usage found by physicians. The system was created for about $25 million, but by 2006 had already saved 425 sepsis-related patient deaths, and cases of ventilator-associated pneumonia fell form 37 in 2005 to 8 in 2006 (Hoffman 2007)

Sutter Health is also rolling out Internet services to physicians and patients. By 2005, all Sutter physicians should have Web access, where they can download charts, check lab results, or order prescriptions. On the patient side, customers can use the Internet to communicate with doctors, view their records, order refills, or get additional instructions. The system is being used by 15,000 patients in Palo Alto (Cuneo 2004).

Sutter Health is using more sophisticated decision support and data analysis tools to help reduce errors and problems throughout the health care process. For example, a data warehouse tracks injuries that occur during childbirth, as well as the frequency of induced labor. The system is being used to reduce the instances of maternal tissue tears (McGee October 2003).

The California Pacific Medical Center in San Francisco is an affiliate of Sutter Health. The Center uses an automated Site of Care (SOC) system to enter data electronically at the bedside. The system saves time and money by reducing transcription costs. It also makes it easy to conduct studies and analyze the data. Reports can be generated quickly in response to physician queries. After a decade of use, the system contains substantial information and knowledge that can be used to improve patient care (Parker 2002).

Pushed in part by the federal government to improve medical care by reducing errors, Sutter Health is adding more support for electronic records keeping. Hummel noted that "my IT employees aren't making widgets, they're saving people's lives," by giving physicians electronic access to information and medical records (McGee 2004). Hummel also reported that California providers were likely to implement complete electronic records in 4-5 years, ahead of the 2014 timetable set by President Bush. Perhaps fueled by the importance of the technology and the enthusiasm of Mr. Hummel, Sutter Health was ranked 18 in *Computerworld's* 2007 "100 Best Places to Work in IT" survey.

Simply storing health records electronically does not solve all problems. Hospitals and physicians also need interoperable electronic health care records. Parsing the jargon, a key strength of electronic records is the ability to share the data with other providers. The U.S. Department of Health and Human Services is working to define standards to support interoperability within the federal government. The agency will provide some software to small and midsize physician practices at low cost (Havenstein 2005b). Sutter Health is building a system to connect its 26 hospitals and more than 5,000 physicians. CIO Hummel observed that much of the data is stored in systems purchased from Epic Systems Corp, but that Sutter's "interface department builds over 800 interfaces a year to integrate all our vendors" (Gilhooly 2005).

In 2010, Sutter Health partnered with iTriage to offer a smartphone app that provides basic medical information including lists of 300 symptoms, 1,000 diseases, and 350 medical procedures. The system also taps a database of every doctor, hospital, urgent care clinic, and pharmacy in the nation—along with directions to health care providers in any community (Merrill 2010).

In 2011, Sutter Health began offering its electronic health record (EHR) system (Sutter Community Connect) to regional physicians in independent practices. Tying more physicians into their system makes it easier to integrate patient data. Jeff Burnich, MD and senior vice president of the Sutter Medical Network noted "To truly reinvent care, we see an imperative to connect as many physicians across our network as possible by extending an HER option to community doctors in independent practice" (Healthcare IT News 2011). The system already connects more than 12,000 caregivers and almost 450,000 patients use Sutter's online services.

Managing the Technology

John Hummel's IT department consists of almost 1,000 employees, with a budget of 3.9 percent of the hospital's net revenue, spending $105 million for operations (Cuneo November 2003). He still manages to send birthday and anniversary cards to each employee every year. But the department is busy, scheduling 750 large-scale projects for 2004 alone (Cuneo December 2003). The state of California essentially mandated the huge number of projects. In 1994, the state passed a law requiring all hospitals to be earthquake proof by 2008. Sutter Health has planned $5 billion in capital improvements. One of the big tasks for Hummel is building a new data center to consolidate all of the servers into one secure, safe location. By 2004, Sutter had completely replaced five hospitals and is planning to rebuild six more. Building the hospitals from scratch means that information systems can be built into them from the beginning (Brewin and Thibodeau 2004).

The hospital company operates in more than 100 communities and needs a network to connect all of the facilities. In 2003, the network team installed high-speed fiber-optic links to the new data center. The 50-micron multimode fiber cable can carry 10 gigabits per second. Chris Kennedy, network engineer for Sutter Health, notes that "we didn't want to impede our LAN system and therefore chose 10 Gbps multimode fiber. Most of our applications at the desk are pushing 100 Mbps though. With the new fiber backbone, we will be ready to easily push one gigabit from our desks without compromising our network." Category 6 cable was run to desktops in anticipation of the need to handle gigabit speeds (Oliver 2003).

Sutter Health is also spending money to improve privacy and protect data—partly driven by the HIPAA regulations. In addition to the common security and privacy controls, the IT department has a team of a half-dozen "white-hat hackers" to continually test the system to look for problems before real hackers can find them (McGee September 2003).

Like several other hospitals, Sutter has turned to wireless networks to provide data services to physicians and nurses as they move throughout the hospital. Today, most patients are give bar-code bracelets. Nurses use a portable scanner to identify the patient, retrieve drug medication information and have the computer match the records to ensure the right patient is given the correct drug at the proper time. Sutter uses Citrix remote terminal software to improve security. Physicians and nurses basically download a screenshot that provides data, but is not stored locally, so the medical provider sees only a small snapshot of the data, not the entire patient record. The wireless network is also secured against eavesdroppers (Havenstein 2005a).

Costs

In 2002, Sutter Health raised its prices to Health Net insurance by 25 percent. After a public battle fought in newspaper ads, 20,000 Health Net members jumped to other insurers to avoid the battle. Ultimately, the two companies negotiated 15 percent annual increases.

In 2003, Sutter Health encountered a more serious public relations problem. Driven by ever-rising prices for health care, several large employers began examining prices at many of the large health care providers in California. Moreover, federal regulators have been examining overpricing claims against many hospitals. In 2003, the Service Employees International Union brought significant pricing data to the attention of several organizations, including CalPers, the large retirement investment agency. They found that five of the Sutter Health hospitals had inpatient charges that were up to 53 percent higher than the national average. Five of its hospitals were also being investigated by the federal Centers for Medicare and Medicaid Services for possible overbilling. In addition, nine of the Sutter Health hospitals had total profit margins exceeding 10 percent in 2001, compared to a state average of 3.5 percent on not-for-profit hospitals (Benko 2003). In early 2004, CalPers dropped 13 of the Sutter Health hospitals from its insurance coverage. It dropped 25 hospitals from other firms. A spokesman said "We wanted to send a message to these providers that their costs are over the top." CalPers provides coverage for 1.2 million state employees, retirees, and their families (Wojcik 2004).

In early 2009, Sutter cut 121 jobs from its IT department in Rancho Cordova to reduce costs. The cut represents about 7 percent of its IT workforce. By that time Sutter had rolled out its electronic health records system to five of its eight physician organizations and one hospital. The company put rollouts on hold to additional hospitals (Monegain 2009). In 2011, Sutter Health signed a contract with outsourcer Affiliated Computer Services (ACS) to run the MIDAS+ health care analytic tools. The DataVision system pulls from existing clinical data and provides reports and analyses, including comparisons with similar activities from healthcare organizations across the nation. Krystin Dozier, Vice President of Clinical Effectiveness at Sutter Health noted that "MIDAS+ DataVision provides us with the comprehensive solution we need to easily view performance across our enterprise. We are particularly excited about 'SmartReport' which shows us, in a volume relative, DRG-weighted priority, those clinical areas and quality issues where we can track issues and target improvement efforts" (MIDAS+ 2011).

Questions

1. What obstacles will Sutter Health face to implement a completely digital health care information system by the end of 2006?
2. Why is Sutter using a data gateway to transfer information across machines instead of standardizing the underlying systems?
3. If Sutter is so advanced in its use of technology, why are its hospitals so expensive?

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www.sutterhealth.com

Case: Beth Israel Deaconess Medical Center

Beth Israel Deaconess Medical Center (BIDMC) in Boston is a teaching affiliate of Harvard Medical School. It is a not-for-profit hospital that is part of the Care-Group Health System. The hospital has 534 beds and a Level 1 Trauma Center. It is a major biomedical research university (bidmc.harvard.edu). Like all hospitals, BIDMC has worked to install information technology to help patients, physicians, and nurses.

Information Technology

Emergency rooms in a major city are always hectic. The ER at BIDMC treats 60,000 patients a year (an average of 164 per day). Triage is the standard medical practice of identifying the most severe cases and treating those first (if the treatment can reasonably be expected to succeed). But with new patients arriving constantly, and nurses and physicians rotating among cases, it can be hard to keep track of the current situation. In the old days, hospitals used white boards to list major issues—but that sacrifices patient privacy and can lead to errors if the board is not updated or erased. At BIDMC, three doctors devised a new solution: an "electronic dashboard" that consists of a four-foot wireless plasma display. Patients are color-coded for severity (red for serious) and by gender (pink or blue). The entire ER was rebuilt with wireless technology in 2002. When a patient arrives, clerks enter registration data into a laptop, and the pertinent data is transferred to the plasma display identifying them by their initials. Unlike other hospitals, patients are immediately moved to beds. The wireless system enables clerks to come to the patients. Dr. John Halamka, CIO of CareGroup notes that "if you think of a traditional emergency department, you walk in and immediately you're sitting at a triage desk. Maybe you're in pain, maybe you can't make it to the desk. Well, that's nuts. We put you in a bed, and then the registration people come to you and take your information" (Ewalt 2001).

Physicians treating patients enter orders and diagnoses into wireless laptops, with notations transferred to the display. When a procedure is completed, such as X-rays, the corresponding display element (XR) turns green. The physician's laptops also connect to the hospital's primary information system, so they can retrieve medical histories. In addition to improving care, the system has made the ER team more efficient. Nearby facilities averaged 450 hours in a six-month period where they had to turn patients away. BIDMC was overloaded only 40 hours in the same time period (MSNBC 2003).

The hospital has created wireless access in some other parts of the hospital. In some wards, patients are even given laptops so that they can check their e-mail or surf the Web. Halamka observes that "unless I'm in critical condition, I need to access the outside world. People are there for a long time, so we give them PCs." To improve privacy and security, the hospital encrypts all wireless transmissions and requires that all wireless devices be registered before being granted access to the network (Ewalt 2001).

In terms of basic data and operations, BIDMC was an early adopter of computerized drug cabinets to monitor inventory levels throughout the hospital. The cabinets have a built-in PC board running a Sybase database and a flat panel display. Located throughout the hospital, they are tied to the central pharmacy to signal when an item needs to be refilled and to provide data for patient billing (Whiting 1999). With the new federal drug bar code regulations, the drug cabinet capabilities will probably not be needed.

Patient Care

As the U.S. population gets more comfortable with online interactions, it is only natural that patients want to be able to e-mail their physicians and obtain advice or renew prescriptions. Many physicians have resisted this technology. Some have claimed they are worried about privacy and liability issues. A few more cynical observers have noted that physicians do not usually get paid for these communications. Either way, few physicians embrace online interactions with patients. In 2004, Blue Cross Blue Shield of Massachusetts began a pilot study with several health care organizations, including 200 physicians at BIDMC. Blue Cross pays doctors $19 for each Web visit, and patients kick in a $5 co-payment. BIDMC anticipates participation by about 250 patients with perhaps two e-visits each for the first year. Contacts and billing are handled through a secure site by RelayHealth (McGee 2004).

Within the hospital, BIDMC is moving to electronic records. It is using a Web-based order-entry system for prescriptions, lab tests, and supplies. The system includes reminders for physicians and nurses and can electronically notify them when lab results come back. Massachusetts requires that all medical data be stored for 30 years, including images such as MRI, ultrasound, and X-ray scans. In addition to meeting state requirements, the system database can be used for data mining (McGee September 2003). Physicians can access stored images almost instantly through the network. Ronald Mitchell, CareGroup's director of radiation information systems, notes that "in the operating rooms, we're installing dual high-resolution flat-panel monitors so that surgeons can view the images prior to and during procedures" (McGee October 2003).

Network Disaster

One of the challenges to an electronic medical system is that it has to keep running—24 hours a day with no interruptions. In November 2002, the network at Beth Israel Deaconess crashed and had to be completely rebuilt in a matter of days. In the meantime, physicians and staff had to resort to paper records that had not been used for years. Dr. Halamka, the CIO, widely reported the problems he encountered, to show other hospitals how to improve their networks.

On Wednesday, November 13, 2002, Halamka noticed that the network was sluggish and taking too long to send and receive e-mail. He talked with the network team, and they had already noticed the problem. It appeared to be coming from a surge in one of the switches. They had experienced these spikes before, but happened to have a consultant on-site looking into the problem with that switch. To help identify the problem, network engineers began shutting down virtual LAN (VLAN) segments. That action was a mistake, because it forced the switches to recalculate the traffic distributions, and all data traffic ground to a halt while the switches continually reconfigured. They quickly turned everything back on, but the network was still sluggish. Around 9 P.M., the engineers spotted the problem: a loop in the spanning tree protocol. When data arrives at a switch, the switch computes the shortest path and directs the message to the destination. The problem was that the spanning tree could only look out to seven hops. Once data travels beyond seven jumps, it can lose its way and get redirected to the beginning—creating a loop. On Wednesday, a researcher had loaded several gigabytes of data into a file-sharing application, and it looped, clogging the network. The network team took standard steps to cut links and reduce the probability of loops and went home for the night.

The next morning, as usage ramped up, the network slowed to a crawl again. The team tried other options with no success. The network was beginning to cause problems for the physicians and patients. One physician was monitoring a critical patient and needed several lab reports to help spot the problem. But it was taking five hours to get lab reports completed. Fortunately, the patient survived. At 3:50 P.M., the hospital closed its emergency room for four hours.

At 4:00 P.M., Halamka called Cisco, their network provider. Cisco triggered its Customer Assurance Program (CAP) where the company commits every resource possible to solving the problem. A nearby team from Chelmsford moved in and set up a command center. Their first problem was that the network was so slow they could not get status information from the switches. They finally found some ancient 28.8Kbps modems to use to bypass the network and found the problem at 9 P.M.. The image archive system was 10 hops away from the closest core network switch. Huge volumes of data were being abandoned because the spanning tree system could only go out to seven hops. The problem was that the network had been cobbled together since 1996 one piece at a time, using outdated switching technology. The team decided to upgrade the backbone to the image system with a Cisco 6509 router/switch. The router element provides more sophisticated communications by constantly evaluating bandwidth and rerouting traffic as needed. Shortly after 9 P.M., Cisco loaded a 6509 onto a commercial flight from San Jose to Boston. Working through the night, the CAP team rebuilt the image network, a task that originally took six months.

The next morning, when the load increased again, the network still began to crash. By 10:00 A.M., Halamka decided to shut down the entire network and revert to paper. Most of the medical staff had already given up on the system anyway. Employees cranked up the copiers to generate blank forms. Some interns and physicians had never used paper prescription forms before and had to be trained. Runners were used to carry the paper and communicate orders.

By Saturday morning, the system was still down. The engineers decided the entire network was outdated. At 5 A.M., three additional Cisco engineers arrived from Raleigh. At 8 A.M., two more 6509 routers arrived by plane from Cisco. The team of 100 people spent the day building a new network. By Saturday night, the new core network was in place. But it took most of the night and Sunday to debug small glitches, such as a dead network card and out-of-date firmware. On Monday morning, the network was finally stable. At noon, Halamka declared the crisis over (Berinato 2003).

The main lesson from the disaster: networks have to be evaluated on a continual basis. You cannot just plug new items in and expect everything to work correctly. You need to have an overall architecture that supports the entire system. And you have to be willing to rebuild and replace core equipment as new technologies are introduced.

Moving Forward

After rebuilding the network and SQL Server databases with highly-redundant systems, the IT system has succeed since 2004 with better than 99.9 percent uptime (Halamka 2007). With the main network problems solved, Beth Israel Deaconess Medical Center continued to expand its use of information technology. In 2004, the hospital, along with the parent company CareGroup, Inc., began installing RFID tags that can be read by hardware from PanGo Networks, Inc. that ties into the wireless Wi-Fi network at the hospital. The hospital is using the tags to track equipment—the PanGo software provides a map of the location of expensive equipment. Halamka noted that the two-campus hospital has millions of dollars of expensive equipment and loses almost $400,000 of equipment a year, "because in the course of normal care, it gets misplaced" (Rosencrance 2004). The system can also be used to monitor the location of medical workers to help locate them in an emergency, or even to locate patients in the future.

Beth Israel Deaconess is one of 31 hospitals in 10 large cities tapped by the Centers for Disease Control and Prevention to provide automated data feeds from its emergency rooms. The CDC is concerned about pandemics and terrorist threats and uses the real-time data collection to help spot early trends. Barry Rhodes, associate director for technology and informatics in the Division of Emergency Preparedness and Response at the CDC observed that "the amount and rate of data streams to CDC is really unprecedented [compared with] what we have done in the past" (Havenstein 2006).

Beth Israel Deaconess and a few other medical providers have begun making patient data available directly to patients via Web sites. Although many are wary of potential privacy issues, the practice has the ability to keep patients more involved, and it gives them the ability to spot and correct errors in the database (McGee 2007).

Beth Israel was one of the first big hospitals to adopt the Apple iPad as a useful device for interacting with physicians. CIO John Halamka was even featured in an Apple video. He noted that "Sometimes doctors are overwhelmed with data. What we have tried to do on the iPad is give doctors at the point of care the tools they need at the exact moment the doctor can make a difference." The doctors can use the devices to retrieve data and even show images to the patients (Merrill 2011).

Questions

1. How does the emergency room system at BIDMC protect patient privacy?
2. Why have physicians been so slow to adopt online and e-mail communications from patients?
3. Why did the BIDMC network get so bad and fail? Why was it not fixed earlier?

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Case: Partners Health care System

Partners Health care System, Inc. is an association of hospitals in the Boston area, including Brigham and Women's Hospital and Massachusetts General Hospital. The not-for-profit organization had revenues of $4.6 billion in 2003. Across the organization, the physicians and staff see 11,000 patients a day (annual report on the company Web site www.partners.org).

Telemedicine

With support from engineers at MIT, the hospitals in Partners were pioneers in the use of telemedicine. The system was created to expand the reach of the organization and provide quality care to patients in outlying areas. The system originally ran on ISDN phone lines with videoconferencing equipment. In 2000, the organization turned to an Internet-based system using Microsoft Windows 2000 Advanced Server. Dr. Joseph Kvedar, director of the Telemedicine Program, notes that "with the help of Windows 2000 Advanced Server, we will be able to extend the reach of our providers around the globe and to take the considerable body of knowledge within our organization and make it available virtually anytime, anywhere" (Microsoft 2000). The system is integrated into Microsoft's Internet Information Server (IIS) to exchange data and information as well as provide video streaming. The unit estimates that there are 20,000 potential users in one target group alone, and the system might eventually reach hundreds of thousands of users. Scalability and network load balancing were critical factors in upgrading the system. To access the system, users need only a Web browser and an Internet connection, as opposed to proprietary commercial lines that were needed with the old system (Microsoft 2000).

Telemedicine offers the possibility of providing detailed expert services to many new areas. However, some serious obstacles remain. Notably, insurance companies are reluctant to pay for the services. In part, they are concerned about fraud and billing abuse. Despite the obstacles, Kvedar says that Partners has seen e-visits increase by 25 percent a year (Kolbasuk 2004). Some home-health nurses are turning to digital cameras and camera-equipped cell phones to treat basic skin problems. They take photos of skin wounds on diabetic patients and transfer them via the Internet to wound specialists. The specialists can examine the patterns using the digital history files. They can also check progress on many patients in one day. Partners is equipping up to 180 nurses with digital cameras or high-resolution cell phone cameras to provide care for 2,800 at-home patients (Kolbasuk 2004).

Knowledge Management

Medicine revolves around a tremendous amount of knowledge. Some of it is generated by research, some by best practices, some by experience. In the mid-1990s, medical researchers were concerned about the high error rates at Brigham and Women's and Massachusetts General hospitals. Sometimes simple things were causing huge problems—such as physicians not knowing a patient's allergies or forgetting that two drugs had bad interaction effects. So, they built a knowledge management system to assist physicians prescribing drugs. Doctors enter orders into the computer and it examines patient data, test results, other drugs, and diagnostic information to evaluate the drug choice. It then makes recommendations. John Glaser, CIO at Partners, notes that serious medication errors have been reduced by 55 percent, and "about 400 times a day, a physician changes his mind on an order based on the computer" (Melymuka 2002). Although that is only 3 percent of the total drug orders, it can save lives. Because the system provides only concrete advice that is not debatable, physician acceptance has been fairly good—even though entering the data can add 30 minutes a day to their workload. One physician even thanked Glaser: "I just want to tell you our system has saved my ass a couple of times" (Melymuka 2002).

Unfortunately, Glaser notes that "Only about 3 percent of hospitals have systems like this. That's because it's hard, but also because the ROI is fuzzy and messy" (Melymuka 2002). The low adoption rate is one of the reasons for the push by President Bush to force hospitals to move to electronic records and track drugs with bar codes. The Center for Information Technology Leadership backed by Partners notes that if the industry can standardize on electronic records, hospitals and insurers could save $86 billion a year (Brewin 2004).

Technology Management

One problem with technology that is rarely discussed outside of IT departments is that individual users often want new projects or special treatment. Special requests can be important and they can be useful, but individual users usually want their pet projects to move to the top of the list. Particularly in healthcare, it is easy for some to argue that their projects can save lives. But, if the IT department spends all of its time responding to special requests, no time will remain for the big projects. Partners Healthcare experienced these problems—particularly since the department did not have a means to track all of the special requests. Mary Finlay, deputy CIO, said the team counted over a 100 ways special requests arrived and that they "were marginalizing resources by spreading them across the special requests plus the major initiatives." To solve the problem, the IT department added a tracking system to handle evaluation and approvals of nonscheduled projects (Artunian 2005).

John Glaser, CIO of Partners Healthcare, realized a major problem was brewing in July 2004. The electronic medical record (EMR) system serving 6,000 physicians and nurses had been suffering from minor problems since the start of 2004, but in July and early August, the system appeared to be melting down—with frequent outages and slowdowns. Partners, Boston's largest hospital group, had been using EMR for 15 years—largely adopted by two big hospitals: Massachusetts General and Brigham and Women's hospitals. The system continued to degrade in August and the IT staff did not have solid answers for the causes. Mr. Glaser brought in IBM consultants, but also spent considerable time deflecting and absorbing criticisms from physicians. He recognized that he had to be visible and talk with the doctors, noting "they are angry and upset, and they want to yell at someone, and it has to be you. You have to roll with it. You have to resist the temptation to fight back." Eventually, his team found the root cause of the problem: failure to upgrade an older operating system that could not handle the load. It required three months to upgrade the system and test everything, but the staff added additional servers to reduce the outages. By the end of December, the new system was in place and working well (Worthen 2005).

Within the general shortage of IT workers in 2010, the issue of hiring for hospital IT is an even greater problem. For example, hospitals located in smaller communities would have problems attracting top talent. Located in Boston, Partners does not have that problem, but Sue Schade, CIO at Brigham and Women's Hospital, part of Partners, noted that recruiting was problematic because the hospital runs its own custom system—not one of the standard systems in the industry such as Epic or Meditech. So, it is not possible to find people with experience, and they have to be trained specifically for the custom system (Monegain December 2010).

New Technologies

In 2005, Partners Healthcare created a pilot project to equip home health care nurses with camera-equipped cell phones. The nurses use the phones to take pictures of wounds and skin lesions and send them immediately to specialist nurses trained in enterostomal therapy (wound care). Doug McClure, corporate manager for telemedicine technology solutions, noted that "there are only so many patients these wound-care nurses would be able to see in a day—and there's only so many of these specialty nurses available." The technology will enable them to work on cases more efficiently. The initial cell phone cameras had limited resolution (1 megapixel), but the organization is looking for higher-resolution phones as the technology improves (McGee 2005). The hospital is also working with Ambient Devices to help remind chronically-ill patients to take their medicine. When patients open a smart pill box, an electronic message is sent to the hospital. The hospital computer then remotely turns a special light at the patient's house from red to green (McGee 2006).

In 2010, Brigham's was one of the hospitals in 15 communities to receive a share of $220 million from the federal government to serve as models for widespread use of healthcare information technology. Jonathan Teich, MD, who is an assistant professor at Harvard and works as an attending physician in emergency medicine at Brigham and Women's Hospital among other jobs noted that "We can read all about how to do it, and we can read books and guidance, but I think that providers really want to see examples of how it's working somewhere else, someplace like them" (Monegain June 2010). The cities became known as Beacon Communities, and each selected specific and measureable goals for improvement.

In 2011, Partners was one of several hospitals to adopt IBM's business analytic technology to examine effectiveness and potential safety issues of pharmaceuticals across a large population of users (Healthcare IT News 2011). The Netezza data warehouse tool will allow researchers to analyze data from millions of de-identified patient records. Examining the massive number of cases across time might reveal interactions or other effects that would be difficult to spot in smaller studies.

Questions

1. Why did it require a federal law for hospitals to adopt bar code systems for drug prescriptions and delivery in hospitals?
2. What are the drawbacks to telemedicine?
3. What will it take for telemedicine to be used more often?

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Summary Industry Questions

1. What information technologies have helped this industry?
2. Did the technologies provide a competitive advantage or were they quickly adopted by rivals?
3. Which technologies could this industry use that were developed in other sectors?
4. Is the level of competition increasing or decreasing in this industry? Is it dominated by a few firms, or are they fairly balanced?
5. What problems have been created from the use of information technology and how did the firms solve the problems?

Glossary

10Base-T A system of connecting computers on a LAN using twisted-pair cable. The method relies on compression to increase raw transfer rates to 10 megabits per second.

24 -7 Operation of an application or database 24 hours a day, 7 days a week. Because the database can never be shut down, performing maintenance is a challenge.

Access speed A measure of disk drive speed. Loosely, the time it takes a disk drive to move to a particular piece of data.

Accounting journal Raw financial transaction data are collected by the accounting department and stored in a journal. Modern accounting requires the use of a double-entry system to ensure accurate data.

Activity-based costing (ABC) ABC allocates costs by examining a detailed breakdown of the production activities. The cost of each process is computed for each different product. The detail provides a better picture of the production cost for each item.

Advanced encryption standard (AES) A new U.S. standard for single-key encryption. Approved in 2001 by the government to replace DES and triple DES. With 128 bit keys, it is substantially more difficult to break; but still very fast to encrypt and decrypt.

Advocacy role Someone in MIS, usually the chief information officer, who bears responsibility for exploring and presenting new applications and uses of MIS within the company.

Agent An object-oriented program designed for networks that is written to perform specific tasks in response to user requests. Agents are designed to automatically communicate with other agents to search for data and make decisions.

American National Standards Institute (ANSI) An organization responsible for defining many standards, including several useful information technology standards.

American Standard Code for Information Interchange (ASCII) American standard code for information interchange. A common method of numbering characters so that they can be processed. For instance, the letter A is number 65. It is slowly being replaced by the ANSI character set table and the use of international code pages that can display foreign characters.

Angel investor An individual who provides a limited amount of funding to start-up firms. Unlike a partner, the investor is rarely involved in management. The amount of funding is generally small--$25,000 to $100,000.

Antitrust laws A variety of laws that make it illegal to use monopoly power. Some basic (economic) actions to achieve a competitive advantage are illegal. Strategic plans must be evaluated carefully to avoid violating these laws.

Application generator A software tool for developers that helps build software applications. It is usually associated with a DBMS but several standalone tools exist to help create new forms and reports.

Application service provider (ASP) A specialized Internet firm that provides an individual application to other businesses. For example, a reservation system can be run by an ASP to provide services to other companies.

Artificial intelligence (AI) An attempt to build machines that can think like humans. Techniques evolved from this research help solve more complex problems. Useful techniques include expert systems, neural networks, massively parallel computers, and robotics.

Aspect ratio Used to define the ratio of width to height in display screens. Standard definition TV was typically 6:4 (such as 640 x 480). HDTV is generally 16:9 (such as 1920 x 1080). Movies sometimes use a 1.85:1 ratio which is slightly wider than the HDTV 1.77:1.

Assumptions Models are simplifications of real life, so they require assumptions about various events or conditions.

Asynchronous Transfer Mode (ATM) A packet-based network system that uses high-speed transmission lines (150 megabits and over) and routers to maximize network efficiency and throughput.

Attributes Descriptions of an object or entity. For example, a customer object would at least have attributes for name, phone number, and address.

Auction In an e-commerce context, a Web-based system where individuals bid for items. Useful when you do not know the exact value of an item or have only a few items to sell. The auction site helps handle payments but charges a percentage fee.

Audit trail The ability to trace any transaction back to its source. In accounting, transaction values are accumulated on the general ledger and used to create reports. An audit trail is a set of marks or records to point back to the original transaction.

Augmented reality A display of a real-world scene with computer-generated data added to it. The computer data often adds names, descriptions, or drawings. For instance, a phone camera might be used to display a scene and tags are added to identify points of interest.

Authentication The ability to verify the source of a message. Dual-key systems are a useful technique. The sender uses a private key to encrypt the message. The recipient applies the sender's public key. If the decrypted message is readable, it had to have come from the alleged sender, because the keys always work in pairs.

Backbone A high-speed communication line that links multiple subnetworks. It is usually a fiber-optic line.

Backward chaining In an expert system, the user enters a "conclusion" and asks to see whether the rules support that conclusion.

Bandwidth Traditionally, the amount of frequency allocated to a communication channel, such as the portion of the spectrum allocated to a single radio or television station. But, the term is commonly used to indicate the basic capacity or transmission speed of a communication channel. For example, 20 megabits per second instead of 5 megahertz.

Bandwidth hogs On a shared network, a small percentage of users will transmit vastly more data than the average user. ISPs often define pricing methods to penalize heavy users to ensure that more bandwidth or capacity is available for all users.

Barriers to entry Anything that makes it more difficult for new firms to enter an industry. Several possibilities would violate antitrust laws. An acceptable barrier is the increased use of information systems, which raises the cost of entering an industry because a rival would have to spend additional money on information technology.

Beginners All-purpose Symbolic Instruction Code (Basic) An early computer programming language designed to be easy to program and to teach. Visual Basic is a current version for Windows programming.

Benchmark A set of routines or actions used to evaluate computer performance. By performing the same basic tasks on several machines, you can compare their relative speeds. Benchmarks are especially useful when the machines use different processors and different input and output devices.

Best practices Methods that are known to work for solving specific problems. Most problems, including those in software development, have multiple solutions. Best practices are a collection of techniques for solving problems that have been tested and avoid common mistakes and problems.

BETWEEN A portion of a SQL statement used to specify a lower and upper bound in a WHERE clause. Commonly used for dates, such as OrderDate BETWEEN 01-Jan-2008 AND 31-Dec-2008.

Bill of materials Used in manufacturing, it is a list of components used to manufacture a finished product. In an ERP system, data from it is often used to trigger inventory deductions and to add the finished product to inventory.

Bill presentation and payment Web-based software that automatically displays bills and invoices for customers. The payment side accepts various forms of payment including credit cards and electronic checks. Generally run as a Web service.

Binary data A collection of ones and zeros called bits. Computer processors operate only on binary data. All data forms are first converted to binary.

Biometrics A field of study that is trying to determine how to identify people based on biological characteristics. The most common devices are fingerprint and handprint readers.

Bit The smallest unit of data in a computer.

All data is converted to bits or binary data. Each bit can be in one of two states: on or off. Bits are generally aggregated into collections called a byte.

Bitmap image A method of storing images. The picture is converted to individual dots that are stored as bits. Once a picture is stored in bitmap form, it is difficult to resize. However, bitmaps are good for displaying photographic images with subtle color shading.

Blog Web log. Say it fast and you can hear the abbreviation. A special type of Web site with software that makes it easy for a user to enter comments. Typically used as a daily journal.

Bluetooth A short-range wireless network technology invented by IBM. It is most commonly used for cell-phone devices such as headsets. The data transmits a 1 mbps up to 32 feet. It is one of the few network protocols to automatically encrypt the data. Newer versions offer higher data rates.

Board of directors A group of people paid to oversee and evaluate the decisions of the company. Technically the CEO reports to the board of directors, but they are charged more with reviewing the CEO's decisions. Most boards have the authority to remove a CEO, but many board members are selected by the CEO.

Boolean search Searching for data by using the logic operators AND, OR, and NOT conditions in a WHERE statement; for example, find a list of customers where city = "Detroit" and age > 50 and do not own a car.

Bottom-up development An approach to designing and building systems in which workers build system components to solve each problem as it arises. Eventually the pieces are combined to create an integrated system. The method relies on standards and controls to facilitate cooperation and integration. See also top-down development.

Brainstorming A group technique in which each individual is asked to come up with possible suggestions to a problem. Any ideas are useful, regardless of how wild they are. Even fanciful ideas could stimulate someone else to improve it or to explore a related area.

Break (report) A report that organizes output by sections that are based on the data values. Common business examples include reports by customer or employee, where data for each person is displayed in a group.

Break footer The section of a break or group report that displays subtotals for the data within the group. See also break.

Break header The section of a break or group report that displays the column headings for the data within the group. See also break.

Broadcasts A technique of transmitting messages using radio, micro, or infrared waves. Broadcast messages are sent to all devices in a certain area. Others in the vicinity can also receive the messages.

Browser A software tool that converts World Wide Web data into a graphical page with hypertext links. Using standard (HTML) commands, companies can offer data and additional links to users. Users simply click on individual words and pictures to retrieve additional data and move to other network sites.

Brute force An attack on encrypted data that attempts to use every possible key. Can be stopped by using very long keys. For example, using a key or password of only three letters means there are only 26*26*26=17,576 possible values. Even a slow computer can test all combinations in a few seconds.

Bulletin board system (BBS) Similar to a typical bulletin board, except that people access it from computers. The BBS enables users to store comments, pictures, and files for other people to retrieve. Bulletin boards are usually organized by topics and can be searched for specific phrases or comments. They are a useful way to disseminate information that is of interest to many different people.

Bus Most computers have special slots called a bus to provide high-speed connections to other devices. Various manufacturers make boards that fit into these slots. The processor can exchange data with these other devices, but performance is sometimes constrained by the design of the bus.

Bus network A network organizing scheme in which each computer is attached to a common transmission medium. Protocols are needed to determine when a machine can transmit and to recover from collisions.

Business process management (BPM) Also see workflow software. The concept that business actions have to be performed in a specific sequence. Managing the process entails finding efficiencies through automating or reordering. For example, purchasing expensive items requires discussions and approvals by a variety of managers.

Business to business (B2B) Business-to-business electronic commerce; sales by suppliers to other businesses over the Internet; often long-term relationships. See B2C and EDI.

Business to consumer (B2C) Business-to-consumer electronic commerce; purchases by individual consumers similar to traditional mail-order systems, but conducted on secure Web sites over the Internet.

Byte A collection of bits. Traditionally, 8 bits make up one byte. From binary arithmetic, an 8-bit byte can hold 2 to the 8th power, or 256, possible numbers. In many systems a byte is used to hold one character.

C A powerful programming language that is flexible and creates efficient code. A language commonly used to build complex applications and to create commercial software products.

C++ An object-oriented extension of the C programming language. It is commonly used to build commercial software. It produces efficient code and supports the development of reusable objects.

Cable modem An Internet connection device that translates local area network protocols to run over a television cable line. It can provide transmission speeds around 1.5 Mbps. But the communication line is shared with other users.

Cache A buffer between the processor and a slower device such as a printer, disk drive, or memory chips. The cache generally consists of high-speed memory. Data is transferred in bulk to the cache. It is then pulled out as it is needed, freeing up the processor to work on other jobs instead of waiting for the slower device to finish.

CAN-SPAM Act The U.S. Act that makes it illegal to send commercial e-mail messages to people who do not want to receive them. For business, the key is that it makes e-mail messages legal, as long as all of the rules are followed.

Capability maturity model integration (CMMI) A system designed at the Carnegie Mellon Software Engineering Institute to help organizations improve their software development processes. A key element is to work toward a formal development model that is measurable and is continually upgraded. The CMMI system is an upgrade of the older CMM process.

Carrier-Sense, Multiple-Access/ Collision Detection (CSMA/CD) A communications protocol that determines how computers will behave on a shared-medium network. Ethernet protocols rely on CSMA/CD. Other alternatives are Token Ring and packet switching.

Case-based reasoning An expert system approach that records information in the form of situations and cases. Users search for cases similar to their current problem and adapt the original solution.

Catalog management system A software tool that holds product descriptions, images, and prices to simplify changing and uploading data to a Web site. It makes it easier to track thousands of products to ensure the Web site data is correct.

CD-ROM Compact disk-read only memory. Data is stored and retrieved with a laser. A special machine is required to create data on a CD-ROM. Used to hold data that does not change very often. Useful for multimedia applications because a disk can hold about 650 megabytes of data. The format used to store music CDs.

Centralization A business scheme for performing most operations and making management decisions from one location in an organization. MIS organization can be examined in four areas: hardware, software, data, and personnel. See also decentralization.

Certificate authority (CA) Dual-key encryption and authentication require that the public key be published and available to others. A certificate authority is an organization that validates the owner's identity, issues the keys, and runs the public directory. Almost anyone can run the software to be a CA, but others must trust that host.

Certifications Vendors provide exams to test workers in their specific technologies and offer a certificate so that potential employers can be sure that job applicants possess a defined level of knowledge. Common certifications include Cisco (networks) and Microsoft (server administration and development). The industry constantly argues over whether certifications have value.

Change agents Objects or people who cause or facilitate changes. Sometimes the change agent might be a new employee who brings fresh ideas; other times change can be mandated by top-level management. Sometimes an outside event such as a competitor or a hurricane forces an organization to change.

Change drivers Concepts or products that have altered the way businesses operate. Classic examples include bar code scanners in retail stores, handheld miniterminals or notebooks by delivery firms and salespeople, and reservation systems by travel and entertainment industries.

Charge-back system A scheme for charging other internal departments for services. For example, some firms charge departments a fee based on how often they use the central computer. The goal is to ration a limited resource by avoiding free use and to provide a lever for user departments to hold MIS accountable.

Chart of accounts A listing of all the accounts and subaccounts in the general ledger. It must be defined ahead of time for each business.

Check in A step in version control systems. When a user is finished making changes to a file, the user checks in the file to the repository to make it fully available to other users. The user must first check out the file.

Check out A step in version control systems. A user checks out a file or document to indicate that changes will be made. To prevent concurrency problems, the document is usually locked so that others cannot make changes at the same time. When finished, the user checks in the file.

Chief executive officer (CEO) The head of a company. The person ultimately responsible for setting the direction and policies of the firm. Usually the CEO is also the chairperson of the board of directors.

Chief information officer (CIO) The person who is in charge of the MIS organization within a firm, charged with overseeing operations, setting MIS priorities, and being a top-level advocate for MIS. Also develops and supports strategy for the firm.

Circular reference In a spreadsheet, a set of cells that eventually refer to each other. In the simplest example, cell A1 would use values stored in cell A2, but cell A2 uses the value stored in A1. This technique is sometimes used to create an iterative solution to a model.

Classes Base descriptions of objects. Technically, classes describe generic attributes and methods. Objects are a specific instance of a class.

Click-through rate Used in Web advertising, the percentage of people viewing an online ad who actually click it to see the details on the advertised product or service. By 2000, the average click-through rates had declined to less than 1 percent. But it is not necessarily a good measure of advertising effectiveness.

Client-server network A network configuration in which a few machines are used as file servers and the others (clients) are independent workstations. Shared data is first sent to a file server where it can be examined or transferred by another client.

Client-server organization A method of organizing the MIS function so that some operations are centralized while others are decentralized. The client-server model separates all of the components into two categories: servers or clients. The functions associated with the server tend to be centralized, whereas the client components and tasks are dispersed among the users.

Clip art Artwork created and sold to be used by nonartists. Hundreds of collections are available of people, places, buildings, and other objects. Clip art images are often used to create presentations and illustrate reports.

Clipboard The method used to transfer data between software packages in windows-oriented operating environments. All objects that are cut or copied are placed onto the clipboard, ready to be pasted to another location or another package. Clipboard viewers exist to show the current contents of the clipboard. Some software systems allow a clipboard to hold several cuttings. Many automatically delete the older cuts—keeping only the most recent.

Clipper chip An encryption method created by the U.S. top-secret National Security Agency (NSA). It uses a secret algorithm to encrypt and decrypt digital messages. It was particularly designed for digital voice communication. Its key feature is the use of two escrow keys assigned to each chip. If the police decide they want to listen to a conversation between two suspects, they can get a court order, collect the escrow keys, and instantly decrypt the call.

Closed loop A system or piece of computer code in which every step in a control mechanism is contained inside the system and does not utilize external input. See also feedback.

Closed system A system that is entirely self-contained and does not respond to changes in the environment. Most closed systems eventually fail due to entropy.

Cloud computing The process of running the main part of an application on servers on the Internet. The servers are generally scalable and provide redundancy. Cloud services available to the public are usually charged on some type of per-use fee basis so firms can buy the level of computing.

CMYK Cyan-Magenta-Yellow-Key (black). A color model used in the printing world to precisely define colors. Colors can be expressed by specifying the percentage needed of each of the primary colors. See also RGB.

Coaxial cable A cable used to transmit data. Cable television is a widespread application. The inner cable is surrounded by a plastic insulator, which is surrounded by a wire mesh conductor and an outer casing. The wire mesh insulates the internal signal wire from external interference.

Cold site A facility that can be leased from a disaster backup specialist. A cold site contains power and telecommunication lines but no computer. In the event of a disaster, a company calls the computer vendor and begs for the first available machine to be sent to the cold site.

Collision In networks, a collision arises when two computers attempt to broadcast messages at the same time. The network protocols need to identify the situation and determine which machine will go first.

Co-location Installing your computer or network equipment in another's facilities to obtain access to high-speed data communication lines. You pay a fee for use of the facilities, power, cooling, and network usage.

Column A vertical part of a table that holds data for one attribute of an entity in a database or spreadsheet. For example, a table to describe automobiles will have columns for make, model, and color.

Command-line interface A method of controlling the computer by typing commands. The user must generally memorize specific commands. Older machines still use them because GUI systems require too much overhead. Some people prefer command lines, because it is faster to type one or two commands than to manipulate an image on the screen.

Commerce server A software system that runs an e-commerce Web server. It handles the product catalog, searching, a shopping cart, and the payment mechanism. Several vendors sell versions to be run on your own server, or you can lease space on a hosting company.

Commercial off-the-shelf software (COTS) Purchased software for building applications. Relatively popular because it is faster than building from scratch.

Common Business-Oriented Language (COBOL) An early programming language designed to handle typical transaction-processing tasks. Its death has been predicted for years, but it is hard to throw away billions of lines of code.

Common Object Request Broker Architecture (CORBA) A model largely developed in the UNIX community that will enable objects to communicate with each other across networks. In particular, it is designed to enable users to combine different data types from various software vendors into a single compound document. The data could reside on any server on the network.

Competitive advantage Something that makes your company better or stronger than your rivals. Examples include lower costs, higher quality, strong ties to loyal customers, and control over distribution channels.

Composite key In defining a database table, each table must have a primary key. When the primary key consists of more than one column, it is referred to as a composite key. The business relationship between the multiple columns are many-to-many.

Compound document A document that incorporates different types of data: text, graphics, sound, and video. The different objects might be transmitted across a network to be included in a final document.

Computer-aided design (CAD) Programs that are used to create engineering drawings. CAD programs make it easy to modify drawings. They also make it easier to keep track of material specifications. They can perform spatial and engineering estimates on the designs, such as surface or volume calculations.

Computer-aided software engineering (CASE) Computer programs that are designed to support the analysis and development of computer systems. They make it easier to create, store, and share diagrams and data definitions. Some versions even generate code. There are two categories of CASE tools: software development and maintenance of existing systems.

Computer-integrated manufacturing (CIM) Using a computer to control most of the production equipment in a manufacturing environment. The computer can monitor the production statistics. It is also used to set individual machine controls.

Computer ethics The concept that all of us have an obligation with respect to data. For example, managers have a responsibility to customers to protect personal data, to collect only data that is truly needed, and to give customers the ability to correct errors in personal data.

Computer information system (CIS) See management information system (MIS).

Composite key In relational databases, a key that consists of more than one column. The columns are combined to yield a unique primary key.

Concurrency A situation that arises when applications attempt to modify the same piece of data at the same time. If two people are allowed to make changes to the same piece of data, the computer system must control the order in which it processes the two requests. Mixing the two tasks will result in the wrong data being stored in the computer.

Content management system Changing text and images on a Web site can be challenging, particularly with thousands of pages and hundreds of contributors. Contributors can write changes in simple text format to a content management system which then formats and uploads the data to the Web site automatically.

Context diagram The top level of a data flow diagram that acts as a title page and displays the boundaries of the system and displays the external entities that interact with the system.

Continuous quality improvement The concept that any process can be improved by continually evaluating the system and making adjustments and refinements. The concept is also applied to service processes, but relies on a measurable performance objective.

Converge The ability of an iterative model to stabilize on a fixed solution. The alternative is that values continually increase and never reach a solution.

Cookies Small text files that a Web server sends to client computers. When the user returns to a site, the browser automatically returns the cookie file. Servers use them to keep track of transactions—so they know when the same user has returned. Marketers have used them to track individual users on the Web.

Copyright A legal ownership right granted to the creators of intellectual property. All works are automatically copyrighted. Registering with the copyright office is not required but grants additional protection to the owner.

Critical success factors A limited number of concrete goals that must be met for the organization to be successful. Identifying these key factors helps determine the strategic directions and highlights the areas that can benefit from improved information systems.

Customer relationship management (CRM) A system for tracking and integrating all customer data. Salespeople, managers, and clerks all have access to the same data, so everyone has the same consolidated view of all customer interactions.

Cut, copy, paste A common mechanism used to transfer and link data between different software packages. The data to be transferred is marked. When it is cut or copied, it is placed on the clipboard. Switching to the second package, the object is pasted into the appropriate location. Dynamic and static links are specified through options in the "paste special" menu. With the cut option, the original object is deleted. With copy, the original is unchanged.

Data Consists of factual elements (or opinions or comments) that describe some object or event. Data can be thought of as raw numbers or text.

Data administrator **MIS manager who** is charged with overseeing all of the data definitions and data standards for the company to ensure that applications can share data throughout the company.

Data dictionary Contains all of the information to explain the terms used to define a system. Often includes report descriptions, business rules, and security considerations.

Data encryption standard (DES) An older method of encrypting data that was commonly used by financial institutions. With current computer capabilities that can break a DES-encrypted message, DES is no longer considered a secure encryption system.

Data flow diagram (DFD) A diagramming technique used to analyze and design systems. It shows how a system is divided into subsystems and highlights the flow of data between the processes and subsystems. It displays processes, external entities, files, data flows, and control flows.

Data independence Separating programs from their data definition and storage. The main advantage is that it is possible to change the data without having to change the programs.

Data integrity (1) A concept that implies data is as accurate as possible. It means the database contains few errors. (2) Keeping data accurate and correct as it is gathered and stored in the computer system.

Data mart A small version of a data warehouse. A database designed to hold concise collections of data for retrieval and analysis by managers.

Data mining An automated system that examines data for patterns and relationships. It is partly based on statistics, but also searches for more specific associations. The results are not always applicable to other situations.

Data mirroring The ultimate backup technique where all data that is stored on one machine is automatically transferred and stored on a second computer. Useful to prevent loss of data and recover from disasters—particularly when the second computer is located many miles away.

Data store A file or place where data is stored. In a realistic setting, a data store could be a computer file, a file cabinet, or even a reference book.

Data types To humans, there are four basic types of data: text and numbers, images, sound, and video. Each data type must be converted to binary form for computer processing.

Data warehouse A single consolidation point for enterprise data from diverse production systems. The data is typically stored in one large file server or a central computer. Because legacy systems are difficult to replace, some data is copied into a data warehouse, where it is available for management queries and analysis.

Database A collection of related data that can be retrieved easily and processed by computers; a collection of data tables.

Database administrator (DBA) (1) A person appointed to manage the databases for the firm. The DBA needs to know the technical details of the DBMS and the computer system. The DBA also needs to understand the business operations of the firm. (2) A management person in the MIS department charged with defining and maintaining the corporate databases. Maintaining data integrity is a key component of the job.

Database management system (DBMS) Software that defines a database, stores the data, supports a query language, produces reports, and creates data-entry screens.

Decentralization Moving the major operations and decisions out to lower levels within the firm. In MIS, decentralization has largely been led by the declining cost and improved capabilities of personal computers. See also centralization.

Decision biases Without models and careful analysis, decisions made by people tend to be biased. There are several biases in each of the four systems categories: data acquisition, processing, output, and feedback.

Decision process The steps required to make a decision. It includes problem identification, research, specification of choices, and the final selection. Midlevel managers are often involved in the initial stages and affect the outcome, even though they may not make the final decision.

Decision support system (DSS) System to use data collected by transaction-processing systems to evaluate business models and assist managers in making tactical decisions. There are three major components: data collection, analysis of models, and presentation.

Decision tree A graphical representation of logic rules. Each possible answer to a question or situation leads to a new branch of the tree.

Default value A value that is automatically displayed by the computer. Users can often override the default by deleting the old value and entering a new one. The goal is to choose a value that will almost always be entered, so the user can skip that item.

Dehumanization Some people feel that technology isolates people and decreases our contact with other members of society. Treating people as identification numbers and summary statistics can lead managers to forget the human consequences of their decisions.

Denial of Service (DoS) Preventing legitimate users access to systems and networks. A common Internet trick is to force thousands of zombie computers to flood a server with millions of meaningless messages—preventing anyone else from using the system.

Descriptive model A model that is defined in words and perhaps pictures. Relationships between objects and variables tend to be subjective. Useful for an initial understanding of a system but difficult to evaluate by computer.

Desktop publishing (DTP) The art of creating professional documents with personal computers and small laser printers. Beyond basic word processing, DTP software provides controls to standardize pages, improve the page layout, and establish styles.

Detail section The section in a report that is repeated for every row in the associated tables. It is often used for itemized values, whereas group and page footers are used for subtotals.

Device drivers Small software modules that provide the interface from an operating system to a hardware device. Manufacturers improve and rewrite their device drives, so you should periodically update your system to obtain the newer drivers.

Diagnostic situations Spotting problems, searching for the cause, and implementing corrections. Examples include responding to exception reports to identify problems and potential solutions, and determining why the latest marketing approach did not perform as well as expected.

Dial-back modem A special modem placed on a central computer. When a user attempts to log in, the dial-back modem breaks the connection and calls back a predefined phone number. Its use minimizes the threat of outsiders gaining access to the central computer.

Digital cash An electronic version of money that is provided and verified by a trusted third party. It consists of an encrypted number for a specified value that can only be used one time. It provides for verifiable and anonymous purchases using networks.

Digital certificate Part of an authentication mechanism used with dual-key encryption. Companies that host servers need to encrypt transactions over the Internet. They purchase a digital certificate from a certificate authority and install it on the Web server. The client browser recognizes the certificate key and encrypts the data.

Digital dashboard A visual presentation of broad measures of current activity in an organization. The data is generally displayed as gauges, and the system must be customized for each organization. As part of an executive information system, managers can drill down to get more data.

Digital divide The distance between those individuals or nations who have network capabilities and those who do not. Despite declining costs, many people and many nations cannot afford the hardware and software. If a large portion of the economy moves online, it could alienate those who cannot afford the network connection.

Digital rights management (DRM) A combination of encryption and Internet validation for protecting vendor copyrights to prevent unauthorized copying of digital content (software, music, books, movies, and so on).

Digital signature Any electronic signature technology that verifies the user. U.S. law now recognizes digital signatures as equivalent to handwritten ones. The most secure system is to obtain a digital certificate from a public company that verifies each person's identity. But the IRS accepts a simple PIN issued by the agency as a digital signature.

Digital subscriber line (DSL) A special phone service connection available to customers within 3 miles of the phone company's switch. It provides about 1 Mbps transmission speed for Internet connections.

Digital video/versatile disk (DVD) A digital format primarily used for storing video and movies. However, it can also hold audio and traditional computer data. One side of the disk can hold over 3 gigabytes of data.

Direct sequence spread spectrum (DSSS) A network transmission protocol commonly used for wireless connections. It subdivides the allocated frequency to send multiple packets at the same time. Communication packets can shift frequencies at each time slot. By making more efficient use of the spectrum, more data can be transmitted.

Disintermediation In an e-commerce context, using a Web-based system to skip over sections of the production chain, such as manufacturers selling directly to consumers. The approach can give the manufacturer a higher percentage of the sale price, but risks alienating retailers, resulting in lost sales.

Distribution center (DC) A central point in a supply chain where incoming bulk goods are split and merged into multiple shipments to the final destination. For example, a truckload of bread would be unloaded and individual boxes placed on other trucks, along with other food items for distribution to a grocery store.

Distribution channel The layers of distributors in between the manufacturer and the final customer. If a producer can gain control over this means of getting the product to the consumers, the producer can prevent new rivals from entering the industry. Improved communication systems offer the possibility of eroding control over some distribution channels.

Diverge The property of an iterative model where successive computations keep leading to larger values (in magnitude). The model never reaches a stable solution. Generally due to insufficient or incorrect feedback mechanisms.

Documentation Descriptions of a system, its components, the data, and records of changes made to the system.

Domain name system (DNS) A set of computers on the Internet that converts mnemonic names into numeric Internet addresses. The names are easier for humans to remember, but the computers rely on the numeric addresses.

Download To transfer files from a remote computer to a local computer (usually a personal computer). See also upload.

Drill down To use an information system to get increasingly detailed data about a company. In an enterprise information system, the ability to look at overall company data, and then select breakdowns by regions, departments, or smaller levels.

Dot-com Abbreviation given to the many Internet firms formed in the late 1990s because their Internet names ended with the .com suffix. For a couple of years, having a dot-com name was prestigious and attracted funding. When hundreds of these firms failed in 2000 and 2001, they became known as dot-bombs.

Dots per inch (dpi) A measure of the resolution of devices including printers and displays. Higher values representing more dots per inch provide more detailed images and text. Some people use the term pixels (ppi) instead of dots.

Drill down The action in a data analysis package or executive information system where the user clicks a link to obtain more detail about a specific situation. See also roll up.

Dual-key encryption A method of encrypting a message that requires two keys: one to encrypt and one to decrypt. One of the keys is a public key that is available to anyone. The other key is private and must never be revealed to other people. RSA is a popular dual-key encryption system. Dual-key systems can also be used to authenticate the users.

Dynamic data exchange An early method of linking data from multiple sources with the Windows operating system. The software packages literally send messages to other software packages, which enables them to combine and update data. See also dynamic integration as well as Object Linking and Embedding (OLE).

Dynamic host control protocol (DHCP) The standard Internet method for assigning Internet addresses to a computer. A DHCP server is given a database with a range of IP addresses and it assigns an unused number to a computer when it requests one on startup. The process means that IP addresses on specific computers can change over time unless the computer is allocated a static address in the database.

Dynamic integration A means of linking data from multiple documents. One compound document (or container) can hold data objects created by other software. As the original data is changed, it is automatically updated in the container document. See also static integration.

e-Business Electronic business. The process of conducting any type of business over the Internet. It includes all forms of e-commerce and m-commerce, as well as internal processes and Web services.

e-Commerce (EC) Electronic commerce. The process of selling items over the Internet. The most familiar form is business-to-consumer, but it includes business-to-business and auction sites like eBay.

e-Discovery Electronic discovery. In legal cases, a request for all electronic data—particularly e-mail communications, but might also include accounting or other data from any computer system. Companies establish policies to define storage life and destruction policies to ensure old data is deleted automatically from systems.

E-mail Electronic mail, or messages that are transmitted from one computer user to another. Networks transfer messages between the computers. Users can send or retrieve messages at any time. The computer holds the message until the recipient checks in.

EBCDIC: Extended Binary Coded Decimal Interchange Code A method of numbering characters so that they can be processed by machines. Used exclusively by large IBM and compatible computers. See also ASCII.

Electronic data interchange (EDI) Exchanging transaction data with entities outside the control of your firm. Private connections can be established directly between two firms. Public networks are also being formed where one provider collects data and routes it to the appropriate client.

Encryption A method of modifying the original information according to some code, so that it can be read only if the user knows the decryption key. It is used to safely transmit data between computers.

End-user development Managers and workers are to develop their own small systems using database management systems, spreadsheets, and other high-level tools.

Enterprise network A network that connects multiple subnetworks across an entire firm. Often, the networks use different protocols and different computer types, which complicates transmitting messages.

Enterprise resource planning (ERP) An integrated computer system running on top of a DBMS. It is designed to collect and organize data from all operations in an organization. Existing systems are strong in accounting, purchasing, and HRM.

Entrepreneurship The act of creating and organizing a business. Generally, an entrepreneur takes the risks to create a new business in search of a profit.

Ergonomics The study of how machines can be made to fit humans better. One of the main conclusions of this research in the computer area is that individuals need to be able to adjust input (and output) devices to their own preferences.

Escrow key In an encryption system, it is a special key that can be used by government officials to decrypt a secret conversation. The Clipper chip uses escrow keys.

Ethernet A network communications protocol that specifies how machines will exchange data. It uses a broadcast system in which one machine transmits its message on the communication medium. The other machines listen for messages directed to them.

Ethics The concept that various elements of society have obligations to the others. In IT, it focuses on the roles of users, developers, and vendors.

Event-driven approach A user-interface approach where the user controls the sequence or operations and the software responds to these events. Events can range from a simple key-press to a voice command. Modern, window-based software does not follow a sequential process. Instead, actions by users generate events. The programs respond to these events and alter data or offer additional choices. Typical events include mouse clicks pointing to items on the screen, keystrokes, changes to values, or transmissions from other systems.

Exabyte A count of the number of bytes one step above petabyte and one below zettabyte. The new IEC definition uses exbibyte for binary data and exabyte only for decimal data which is 10^{18}.

Exbibyte The new IEC definition for binary-based counting instead of exabyte. The binary version is 2^{60}. Technically 2 raised to the 60th power or 1024*1024*1024*1024*1024*1024 (6 times).

Exception report Report that is triggered by some event to signify a condition that is unusual and needs to be handled immediately.

Executive information system (EIS) A type of decision support system that collects, analyzes, and presents data in a format that is easy to use by top executives. To achieve this objective, the EIS is based on a model of the entire company. In most cases the model is presented graphically and the executives retrieve information by pointing to objects on the screen.

Exhaustive testing Testing every possible combination of inputs to search for errors. Generally not a feasible option, so most computer systems will always contain errors.

Expert system (ES) System with the goal of helping a novice achieve the same results as an expert. They can handle ill-structured and missing data. Current expert systems can be applied only to narrowly defined problems. Diagnostic problems are common applications for expert systems.

Expert system shell A program that provides a way to collect data, enter rules, talk to users, present results, and evaluate the rules for an expert system.

Export An older method of exchanging data among various software packages. One package exports the data by storing it in a format that can be read by other software. Object Linking and Embedding is a more powerful way to exchange data.

Extensible business reporting language (XBRL) A specific XML style for reporting financial data in a standard way. Predefined tags are used to mark the financial data to make it easier for computers to extract and compare data from diverse companies.

Extensible markup language (XML) A tag-based notation system that is used to assign names and structure to data. It was mainly designed for transferring data among diverse systems.

External agents Entities that are outside the direct control of your company. Typical external agents are customers, suppliers, rivals, and governments. Competitive advantages can be found by producing better-quality items or services at a lower cost than your rivals. Also, many firms have strengthened their positions by building closer ties with their suppliers and customers.

External entity Objects outside the boundary of a system that communicate with the system. Common business examples include suppliers, customers, government agencies, and management.

Extraction, transformation, and loading (ETL) The process in data warehouses that involves taking data from existing systems, cleaning it up, and moving it into the data warehouse.

Extranet A network configured to give certain outsiders, usually customers and suppliers, limited access to data using Web-based systems.

Extreme programming (XP) A new version of development loosely based on prototyping. Pairs of developers rapidly build and simultaneously test applications. The goal is to build releases and then modify them to meet the changing needs of the users.

Facsimile (Fax) A combination scanner, transmitter, and receiver that digitizes an image, compresses it, and transmits it over phone lines to another facsimile machine.

Fault tolerance The ability of a computer or a system to continue functioning properly even if some of the components fail. Fault-tolerant machines rely on duplication of subsystems with continuous monitoring and automatic maintenance calls.

Feasibility study A quick examination of the problems, goals, and expected costs of a proposed system. The objective is to determine whether the problem can reasonably be solved with a computer system.

Feedback Well-designed systems have controls that monitor how well they meet their goals. The information measuring the goals and providing control to the system is known as feedback.

Fiber optic cable A thin glass or plastic cable that is internally reflective. It carries a light wave for extended distances and around corners.

File server Computer on a network that is used to hold data and program files for users to share. To be effective, it should use a multitasking operating system.

File transfer protocol (FTP) A standard method of transferring files on the Internet. If you control a computer, you can give other users access to specific files on your computer without having to provide an account and password for every possible user.

Firewall A small, fast network computer device that examines every packet entering a company. Rules or filters can be created that will reject certain packets that are known to be dangerous to the network.

First mover In a model of rivalry, the firm that takes the initial action. Sometimes the first mover gets a benefit by setting the strategy and the market. But the costs are often higher because the technology is newer. Games such as chess recognize that the first mover has a slight benefit.

Five Forces model Michael Porter's model used to search for competitive advantage. The Five Forces are: rivals, customers, suppliers, potential competitors, and substitute products.

Floating point operations per second (FLOPS) The number of mathematical calculations a processor can perform in one second. Typically measured in millions (mega-FLOPS) or billions (giga-FLOPS). Bigger numbers represent faster processors.

Flow chart An old pictorial method for describing the logic of a computer program. It has largely been replaced by pseudocode.

Font size An important characteristic of text is its size. Size of type is typically measured in points. For reference, a capital letter in a 72-point font will be approximately 1 inch high.

Forward chaining In an expert system, the ES traces your rules from the data entry to a recommendation. Forward chaining is used to display questions, perform calculations, and apply rules.

Frame A related set of information that humans group together. Sometimes groupings can be arbitrary. A concept used in discussing AI applications and human cognition.

Frame relay A network communication system that uses variable-length packets. It is useful for high-speed, large bursts of data. It is being used for long-distance network communications.

Franchise A means of organizing companies. Independent operators pay a franchise fee to use the company name. They receive training and benefit from the name and advertising of the parent company. They purchase supplies from the parent company and follow the franchise rules.

Frequency division multiplexing (FDM) Supporting multiple communications at the same time by assigning a specific frequency range to each participant. For example, television and radio stations are assigned specific frequency ranges to avoid collisions.

Front-end processor A simple communications device for large central computers that accepted all of the terminal wires and then assigned each user to an open communications port on the computer. This device decreased the number of physical access ports required on the computer.

Full duplex A method of transferring data, usually over phone lines, so that data is transmitted in both directions simultaneously. In terms of speaker phones, it means that people on both ends of a call can talk at the same time. With half duplex, the initial speaker blocks others from talking.

Functions See methods.

Fuzzy logic A way of presenting and analyzing logic problems that is designed to handle subjective descriptions (e.g., hot and cold).

General ledger A collection of accounts that break financial data into specific categories. Common categories include accounts receivable, accounts payable, inventory, and cash.

Geographic information system (GIS) Designed to identify and display relationships among business data and locations. Used to display geographical relationships. Also used to plot delivery routes and create maps.

Gibibyte The IEC definition for billion in binary base 2 (2^{30}). It replaces the term gigabyte which now is to be used for decimal billion.

Gigabyte Approximately 1 billion bytes of data. Technically, 2 raised to the 30th power or 1024*1024*1024 (3 times). It is one step above megabyte and one below terabyte..

Global positioning system (GPS) A system of 24 satellites created by the U.S. Department of Defense. The civilian receivers will identify a location to within about a few feet. Used for navigation, track vehicles, and plotting delivery routes.

Graphical user interface (GUI) A system that is based on a graphics screen instead of simple text. Users perform tasks by clicking a mouse button on or manipulating objects on the screen. For example, copies are made by dragging an item from one location on the screen to another. Pronounced as "gooey."

Grid computing A system that networks multiple computers so that they cooperatively process the designated tasks, effectively functioning as a single computer.

Group breaks Reports are often broken into subsections so that data in each section is grouped together by some common feature. For example, a sales report might group items by department, with subtotals for each department.

Group decision support system (GDSS) A type of groupware that is designed to facilitate meetings and help groups reach a decision. Each participant uses a networked computer to enter ideas and comments. Votes can be recorded and analyzed instantly. Comments and discussion are automatically saved for further study.

Groupware Software designed to assist teams of workers. There are four basic types: communication, workflow, meeting, and scheduling. The most common is communication software that supports messages, bulletin boards, and data file transfers and sharing.

Hacker Primarily used to indicate a person who devotes a great deal of time trying to break into computer systems.

Hardware The physical equipment used in computing.

High-bandwidth digital content protection (HDCP) The digital rights management technology created by the movie and television industries to make it more difficult for people to copy high-definition TV signals. To play protected videos all of your equipment will need to support the HDCP standard.

High-Definition Television (HDTV) Transmission of television signals in digital form. It provides clearer reception. It also supports encrypted transmissions so that broadcasters can control who receives the images. HDTV also supports compression, so that more data (better pictures or more channels) can be transmitted in the same frequency space.

Hot links See dynamic integration.

Hot site A facility that can be leased from a disaster backup specialist. A hot site contains all the power, telecommunication facilities, and computers necessary to run a company. In the event of a disaster, a company collects its backup data tapes, notifies workers, and moves operations to the hot site.

Hub A network device used to connect several computers to a network. Commonly used in a twisted-pair LAN. A cable runs from each computer's NIC to the hub. The hub is often connected to a router.

Hypertext markup language (HTML) The standard formatting system used to display pages on the Internet. Special tags (commands inside angle braces, e.g., <HTML>) provide formatting capabilities. Several software packages automatically store text in this format, so users do not have to memorize the tags.

Icon A small picture on a computer screen that is used to represent some object or indicate a command. A classic example is the trash can used to delete files on the Apple Macintosh.

Image A graphic representation that can be described by its resolution and the number of colors. They can be stored as bit-mapped or vector images.

Import An older method of exchanging data among various software packages. Most software (e.g., a database management system) can export or store data in a text file format. Another software package (e.g., a spreadsheet) can import or retrieve this data. Object Linking and Embedding is a more powerful way to exchange data.

Inference engine Within an expert system, the inference engine applies new observations to the knowledge base and analyzes the rules to reach a conclusion.

Information Data that has been processed, organized, and integrated to provide insight. The distinction between data and information is that information carries meaning and is used to make decisions.

Information center An MIS group responsible for supporting end users. It typically provides a help desk to answer questions, programmers who provide access to corporate databases, training classes, and network support people to install and maintain networks.

Information rights management (IRM) A system to control exactly what each group can do with digital data, including documents, music, and video files. A good IRM system can prevent a document from being read by outsiders, even if the document is somehow shipped outside the company's computers.

Information system A collection of hardware, software, data, and people designed to collect, process, and distribute data throughout an organization.

Information technology (IT) The hardware and software used to create an information system. Sometimes used as an abbreviation for management information systems.

Information threats There are two classes of threats to information: (1) physical, in the form of disasters; and (2) logical, which consists of unauthorized disclosure, unauthorized modification, and unauthorized withholding of data. The primary source of danger lies with insiders: employees, ex-employees, partners, or consultants.

Information warfare (IW) The use of information in a conflict setting. It includes protecting your own information, providing misinformation to the enemy, and monitoring and disrupting the enemy's information.

Inheritance Creation or derivation of objects from other object classes. Each derived class inherits the attributes and methods of the prior class. For example, a savings account object can be derived from an account object. The savings account object will automatically have the same attributes and methods. Attributes and methods specific to the savings account can be added.

Initial public offering (IPO) The step when firms first sell stock to the public. A method of raising additional funds and a major step for most start-up firms.

Input devices People do not deal very well with binary data, so all data forms must be converted into binary form for the computer. Input devices—for example, keyboards, microphones, and bar code readers—make the conversion.

Input-Process-Output A shorthand description of a subsystem. Each subsystem receives inputs and performs some process. The output is passed to another subsystem.

Instant Messaging (IM) A two-way

electronic communication in real time. Short comments that you type are immediately displayed on the recipient's screen. It generally requires that both parties run the same software.

Integrated data The practice of combining data from different sources to make a decision. Data can come from different departments throughout the business, and it can come in many different forms. Networks, groupware, and products that support dynamic linking are all useful tools to integrate data to make better decisions.

Integrated Services Digital Network (ISDN) A set of services, and a transmission and control system, offered by telephone companies. It uses complete digital transmission of signals to improve transmission speed and quality.

Intellectual property As defined by copyright laws, the concept that property such as music, books, software, and movies can be protected. The laws clearly define the owners of the property and specify that the owners can establish any type of copy protections they desire.

Internet A collection of computers loosely connected to exchange information worldwide. Owners of the computers make files and information available to other users. Common tools on the Internet include e-mail, ftp, telnet, and the World Wide Web.

Internet Assigned Numbers Authority (IANA) The Internet committee that is responsible for allocating IP address segments. It generally focuses on technical issues, manages the DNS root zone and coordinates the global numbering system.

Internet Corporation for Assigned Names and Numbers (ICANN) The Internet committee founded in 1998 that coordinates the Internet naming system. It is largely a political committee, formed within the United States, but with international membership, it discusses new top level domains, internationalization issues and so on.

Internet Engineering Task Force (IETF) The primary technical committee that defines Internet standards. It is responsible for standards such as router protocols and HTML.

Internet service provider (ISP) A private company that provides connections to the Internet. Individuals pay a fee to the ISP. The ISP pays a fee to a higher-level provider (e.g., NSP) to pass all communications onto the Internet.

Intranet A network within an organization that utilizes standard Internet protocols and services. Essentially, this includes Web sites that are accessible only for internal use.

Intrusion detection system (IDS) A software tool containing sensors and a set of rules that monitors network traffic looking for attackers. Snort is a commonly-used tool for IDS because it is freely available from the open-source community.

Intrusion prevention system (IPS) Similar to an IDS but more active. It uses software to monitor network activity and a set of rules to indicate when an attack occurs. It then uses router and system commands to shut down or delay access to attackers.

Iterative solution Building a model and evaluating it until the parameter values converge to a fixed solution. Sometimes an iterative model will diverge and never reach an acceptable solution. See also circular reference.

Intrusion detection system (IDS) A combination of hardware and software that monitors packets and operations on the network and computers. It watches for suspicious patterns that might indicate an attack.

Internet Protocol version 6 (IPv6) A set of standards that define how raw data is transmitted on the Internet and how machines are addressed. Version 6 contains several improvements to the older version 4. For example, version 6 supports 128-bit addresses compared with 32 bits in version 4. It will take several years for people to move to version 6.

Joint application design (JAD) A method to reduce design time by putting everyone in development sessions until the system is designed. Users, managers, and systems analysts participate in a series of intense meetings to design the inputs (data and screens) and outputs (reports) needed by the new system.

Just-in-time (JIT) inventory A production system that relies on suppliers delivering components just as they are needed in production, instead of relying on inventory stocks. JIT requires close communication between manufacturers and suppliers.

Kerberos A security system created at MIT that enables systems to have a single sign-on. Users log into the Kerberos server and other systems can validate the user's identity from that server. Much simpler than requiring users to log in multiple times. Named after the hound that guards the gates of Hades (spelled Cerberus in Latin).

Kilobyte Approximately one thousand bytes of data. Technically it is 2 to the tenth, or 1024. The next step up is megabyte.

Knowledge A higher level of understanding, including rules, patterns, and decisions. Knowledge-based systems are built to automatically analyze data, identify patterns, and recommend decisions.

Knowledge base Within an expert system, the knowledge base consists of basic data and a set of rules.

Knowledge engineer A person who helps build an expert system by organizing the data, devising the rules, and entering the criteria into the expert system shell, trained to deal with experts to derive the rules needed to create an expert system. The engineer also converts the data and rules into the format needed by the expert system.

Knowledge Management (KM) A system that stores information in the context of a set of decisions. It contains cross-references and search methods to make it easy for workers to understand how and why decisions were made.

Last mile The connection from an ISP to individual households and businesses. In many cases, the most difficult connection to make because of the cost and monopoly control. Most households are limited to a few choices: telephone and cable TV. Some technologies exist to run communications over power lines. The other option is wireless.

Latency The delay between initiating an action and seeing a result. In communications, it is the delay between sending a message and receiving a reply. Often a problem with satellite connections because the signal must travel huge distances.

Legacy system Information systems that were created over several years and are now crucial to operating the company. They probably use older technology, and the software is difficult to modify. However, replacing them is difficult and likely to interfere with day-to-day operations. Any changes or new systems must be able to work with the older components.

LIKE An SQL command used within a WHERE clause to search for patterns in text. Two pattern-matching characters are used. A % (* in Access) matches any characters. An _ (? in Access) matches exactly one character. For example, WHERE LastName LIKE 'Jo*', matches any last name beginning with those two letters.

Limited liability company (LLC) A legal variation of organizing a company. It protects the owners with the same separation of funds offered to corporations, but because it does not allow it to issue stock, the record keeping is somewhat easier.

Local area network (LAN) A collection of personal computers within a small geographical area, connected by a network. All of the components are owned or controlled by one company.

Magnetic hard drives Magnetic hard drives (or disk drives) consist of rigid platters that store data with magnetic particles. Data is accessed by spinning the platters and moving a drive head across the platters to access various tracks.

Magnetic ink character recognition (MICR) A special typeface printed with ink containing magnetic ink. It can be read rapidly and reliably by computers. Banks are the primary users of MICR. Checks are imprinted with MICR routing numbers. MICR readers are more accurate than straight OCR because they pick up a stronger signal from magnetic particles in the ink.

Mail filters Programs that automatically read e-mail and sort the messages according to whatever criteria the manager prefers. Junk mail can be discarded automatically.

Malware A generic term used to describe software that does nasty things. It includes viruses, Trojan Horses, spyware, and so on.

Management information system (MIS)

An MIS consists of five related components: hardware, software, people, procedures, and databases. The goal of management information systems is to enable managers to make better decisions by providing quality information.

Manufacturing Resource Planning (MRP II) An integrated approach to manufacturing. Beginning with the desired production levels, we work backward to determine the processing time, materials, and labor needed at each step. These results generate schedules and inventory needs. Sometimes known as a demand-pull system.

Market basket analysis A data mining technique pioneered to see if two items are commonly purchased at the same time. Can also be used to identify any pairs of items that are associated with each other.

Mass customization The ability to modify the production line often enough to produce more variations of the main product. The goal is to cover virtually all of the niche markets.

Materials requirements planning (MRP) An early production system, where at each stage of production, we evaluate the usage of materials to determine the optimal inventory levels.

Mathematical model A model that is defined by mathematical equations. This format is easy to use for forecasts and for simulation analyses on the computer. Be careful not to confuse precision with accuracy. A model might forecast some value with great precision (e.g., 15.9371), but the accuracy could be quite less (e.g., actual values between 12 and 18).

Mebibyte (MiB) An International Electrotechnical Commission (IEC) replacement for the term megabyte. Mebibyte is base 2 (2^{20}), megabyte is for base 10 (10^6).

Media For transmissions, the means of connecting computers in a network. Common methods include twisted-pair and coaxial cable; fiber-optic lines; and radio, micro, and infrared waves.

Media access control (MAC) The network protocol that governs how data bits are sent across a connection medium. Almost always implemented in a LAN card. It is most commonly noticed when you need to control security based on physical cards—in which case you need the MAC address that is uniquely assigned to every network interface card.

Megabyte Loosely, 1 million bytes of data. Technically, it is 1,048,576 bytes of data, which is 2 raised to the 20th power or 1024*1024. The next step up is gigabyte.

Megaflops Millions of floating-point operations per second. A measure of the processor speed, it counts the number of common arithmetical operations that can be performed in one second.

Megahertz One million cycles per second, a measure of the clock chip in a computer, which establishes how fast a processor can operate.

Menu tree A graphical depiction of the menu choices available to users in a system.

Metadata Describes the source data, and the transformation and integration steps, and defines the way the database or data warehouse is organized.

Methods Descriptions of actions that an object can perform. For example, an employee object could be hired, promoted, or released. Each of these functions would necessitate changes in the employee attributes and in other objects. The methods carry out these changes.

Microsecond One-millionth of a second. Few computer components are measured in microseconds, but some electrical devices and controllers operate in that range. One microsecond compared to one second is the same as comparing one second to 11.6 days.

Million instructions per second (MIPS) A measure of computer processor speed. Higher numbers represent a faster processor. However, different brands of processors use different instruction sets, so numbers are not always comparable.

Millisecond One-thousandth of a second. Disk drives and some other input and output devices perform operations measured in milliseconds. One millisecond compared to one second is the same as comparing 1 second to 16.7 minutes.

Mirror drive A backup system where data is automatically written to a second disk drive. If the primary drive fails, operations can be switched instantaneously to the mirror drive.

Model A simplified, abstract representation of some real-world system. Some models can be written as mathematical equations or graphs; others are subjective descriptions. Models help managers visualize physical objects and business processes. Information systems help you build models, evaluate them, and organize and display the output.

Modem Modulator-demodulator. A device that converts computer signals into sounds that can be transmitted (and received) across phone lines.

Morphing Digital conversion of one image into another. The term is an abbreviation of metamorphosis. True morphing is done with digital video sequences, where the computer modifies each frame until the image converts to a new form.

Motherboard The main board in a computer that contains sockets for the process and RAM. It also contains an interface bus so that interface cards can be added to the system.

Multimedia The combination of the four basic data types: text, sound, video, and images (animation). In its broadest definition, multimedia encompasses virtually any combination of data types. Today, it typically refers to the use of sound, text, and video clips in digitized form that are controlled by the computer user.

Multitasking A feature of operating systems that enables you to run more than one task or application at the same time. Technically, they do not run at exactly the same time. The processor divides its time and works on several tasks at once.

Musical Instrument Data Interchange (MIDI) A collection of standards that define how musical instruments communicate with each other. Sounds are stored by musical notation and are re-created by synthesizers that play the notes.

Nanosecond One-billionth of a second. Computer processors and memory chips operate at times measured in nanoseconds. One nanosecond compared to 1 second is the same as comparing 1 second to 31.7 years.

Natural language A human language used for communication with other humans, as opposed to a computer programming language or some other artificial language created for limited communication.

Near-field communication (NFC) A very short range wireless communication method useful for touchless payments because the short range makes it difficult to intercept the transmission or misidentify the sender. Typically a range of a few centimeters with a relatively low bandwidth. Similar to RFID, but with a shorter range.

Network A set of items connected together. In MIS, it is typically a connection of computers. And social networks are connections of people.

Network address translation (NAT) A network configuration where internal computers use non-routable addresses (usually in the 10.0.0.0 range). When connecting to devices on the Internet, the boundary router temporarily assigns a real IP address and then directs the incoming messages to the original computer by changing the address within the packets.

Network attached storage (NAS) A disk drive unit that stands alone and is connected to the high-speed local area network instead of directly to a single computer. Similar to a SAN but it uses standard network connections and is accessible to any computer attached to the network.

Network effect The concept that a network becomes more valuable and useful as the number of participants increases. In social networks, larger networks attract more people, enabling them to grow even larger.

Network interface card (NIC) The communication card that plugs into a computer and attaches to the network communication medium. It translates computer commands into network messages and server commands.

Network operating system (NOS) A special operating system installed on a file server, with portions loaded to the client machines. It enables the machines to communicate and share files.

Network service provider (NSP) A high-level Internet service provider offering connections to ISPs. The NSP leases high-speed, high-capacity lines to handle the communication traffic from hundreds of ISPs.

Neural network A collection of artificial neurons loosely designed to mimic the way the human brain operates. Especially useful for tasks that involve pattern recognition.

Neuron The fundamental cell of human brains and nerves. Each of these cells is relatively simple, but there are approximately 100 million of them.

Newsgroups A set of electronic bulletin boards available on the Internet. Postings are continuously circulated around the network as people add comments.

Nondisclosure agreement (NDA) A written agreement where the signer agrees to keep certain information confidential and not tell anyone. Commonly used by startup companies to keep basic technology, general operating practices, and marketing plans secret.

Normalization A set of rules for creating tables in a relational database. The primary rules are that there can be no repeating elements and every nonkey column must depend on the whole key and nothing but the key. Roughly, it means that each table should refer to only one object or concept.

Numbers One of the basic data types, similar to text on input and output. Attributes include precision and a scaling factor that defines the true size or dimension of the number.

Object A software description of some entity. It consists of attributes that describe the object, and functions (or methods) that describe the actions that can be taken by the object. Objects are generally related to other objects through an object hierarchy.

Object hierarchy Objects are defined from other base objects. The new objects inherit the properties and functions of the prior objects.

Object Linking and Embedding (OLE) A standard created by Microsoft for its Windows operating system to create compound documents and dynamically link data objects from multiple software packages. You begin with a compound document or container that holds data from other software packages. These data objects can be edited directly (embedded). Most OLE software also supports dynamic linking.

Object orientation An approach to systems and programming that classifies data as various objects. Objects have attributes or properties that can be set by the programmer or by users. Objects also have methods or functions that define the actions they can take. Objects can be defined from other objects, so most are derived from the four basic data types.

Object-oriented DBMS A database system specifically created to hold custom objects. Generally supports developer-defined data types and hierarchical relationships.

Object-oriented design The ultimate goal of the object-oriented approach is to build a set of reusable objects and procedures. The idea is that eventually, it should be possible to create new systems or modify old ones simply by plugging in a new module or modifying an existing object.

Object-oriented programming (OOP) The process of writing software using sets of extensible objects. Programmers first create objects that encapsulate internal data structures with software methods. New objects can be created by inheriting properties and methods from more generic classes. A goal of OOP was to encourage reuse of objects to reduce the time it takes to create new applications.

Offshoring The practice of sending jobs to an outside contractor located in a different country.

One-to-many relationship Some object or task that can be repeated. For instance, a customer can place many orders. In database normalization, we search for one-to-many relationships and split them into two tables.

Online analytical processing (OLAP) A computer system designed to help managers retrieve and analyze data. The systems are optimized to rapidly integrate and retrieve data. The storage system is generally incompatible with transaction processing, so it is stored in a data warehouse.

Open operating system An operating system that is supposed to be vendor neutral. It should run on hardware from several different vendors. When a buyer upgrades to a new machine, the operating system and software should function the same as before.

Online transaction processing (OLTP) A computer system designed to handle daily transactions. It is optimized to record and protect multiple transactions. Because it is generally not compatible with managerial retrieval of data, data is extracted from these systems into a data warehouse.

Open source development A method of creating software where the source code is released to the public and anyone can contribute to the project by writing sections of the code. Usually one person takes the lead to control the integration changes and planning for new releases. The Linux operating system initiated by Linus Torvalds is a common example.

Open system An open system learns by altering itself as the environment changes.

Operating system A basic collection of software that handles jobs common to all users and programmers. It is responsible for connecting the hardware devices, such as terminals, disk drives, and printers. It also provides the environment for other software, as well as the user interface that affects how people use the machine.

Operations level Day-to-day operations and decisions. In a manufacturing firm, machine settings, worker schedules, and maintenance requirements would represent management decisions at the operations level. Information systems are used at this level to collect data and perform well-defined computations.

Optical character recognition (OCR) The ability to convert images of characters (bitmaps) into computer text that can be stored, searched, and edited. Software examines a picture and looks for text. The software checks each line, deciphers one character at a time, and stores the result as text.

Optimization The use of models to search for the best solutions: minimizing costs, improving efficiency, or increasing profits.

Output devices Data stored in binary form on the computer must be converted to a format people understand. Output devices—for example, display screens, printers, and synthesizers—make the conversion.

Outsourcing The act of transferring ownership or management of MIS resources (hardware, software and personnel) to an outside MIS specialist.

Packets Network messages are split into packets for transmission. Each packet contains a destination and source address as well as a portion of the message.

Packet switching network A communications protocol in which each message is placed into smaller packets. These packets contain a destination and source address. The packets are switched (or routed) to the appropriate computer. With high-speed switches, this protocol offers speeds in excess of 150 megabits per second.

Page footer Data that are placed at the bottom of each page in a report. Common items include page totals and page numbers.

Page header Data that is placed at the top of every page in a report. Common items include the report title, date, and column labels.

Parallel processing Using several processors in the same computer. Each processor can be assigned different tasks, or jobs can be split into separate pieces and given to each processor. There are a few massively parallel machines that utilize several thousand processors.

Parameter Variables in a model that can be controlled or set by managers. They are used to examine different situations or to tailor the model to fit a specific problem.

Patent Legal protection for products (and sometimes business processes). It grants the owner sole right to sell or create modifications of the product for 20 years. No one can create the same product unless approved by the patent owner.

Peer-to-peer communication A method of sharing data and information directly with colleagues and peers, instead of transferring data through a shared central server.

Peer-to-peer network A network configuration in which each machine is considered to be an equal. Messages and data are shared directly between individual computers. Each machine continuously operates as both a client and a server.

Personal digital assistant (PDA) A small, portable handheld computer designed primarily to handle contacts, schedules, e-mail, and short notes. Some models have more advanced features to support documents, spreadsheets, photos, and music. A few have wireless connections; others have to be synchronized with desktops to transfer e-mail and update schedules. Replaced by smartphones.

Pebibyte The new IEC definition for quadrillion bytes in binary (2^{50}) denoted PiB. It replaces the term petabyte which is now to be used for decimal values. Technically 2 raised to the 50th power or 1024*1024*1024*1024*1024 (5 times).

Petabyte One quadrillion bytes of data. One step above terabyte and one below exabyte. The new IEC definition uses pebibyte for binary data and petabyte for decimal values or 10^{15}.

Phased implementation An implementation method that introduces the new system in phases or steps. One phase is completed before the next is undertaken. The pieces could be software components, different divisions, different locations, or a similar split.

Phishing Pronounced as fishing. The act of sending out false messages, typically pretending to be from a bank, in an attempt to get users to provide usernames and passwords to access sensitive systems. Almost any e-mail message purportedly sent to you by a financial institution should be ignored. Anything that does not include your name should be deleted immediately.

Photo-CD A standardized system created by Kodak to convert photographs to digital (bitmap) form and store them on optical disks.

Pivot table A tool within Microsoft Excel used to extract and organize data. It enables users to examine aggregated data and quickly see the accompanying detail.

Pixel Picture element, or a single dot on an image or video screen.

Podcast An audio message distributed via a Web site designed for storage and playback on an Apple iPod. But the term today includes almost any type of audio file containing messages.

Point of sale (POS) system A means of collecting data immediately when items are sold. Cash registers are actually data terminals that look up prices and instantly transmit sales data to a central computer.

Polymorphism In an object design, different objects can have methods that have the same name but operate slightly differently. For example, a checking account object and a savings account object could each have a method called pay interest. The checking account might pay interest monthly, whereas the savings account pays it quarterly.

Portable document format (PDF) A file format often used on the Internet. It can display documents with detailed precision, including special fonts and shading. Defined by Adobe, readers are freely available for many machines. Special software must be purchased to create the files.

Precision (numeric) In computers, numeric precision represents the number of digits stored to the right of the decimal point. So, 10.1234 is more precise than 10.12; however, it is not necessarily more accurate. The original value might not have been measured beyond two digits.

Prediction Model parameters can be estimated from prior data. Sample data is used to forecast future changes based on the model.

Pretty good privacy (PGP) A dual-key encryption system based on the Diffie-Hellman approach similar to RSA. Created by Philip Zimmermann and commonly used to encrypt e-mail. Free copies for noncommercial use are still available from MIT.

Primary key A column or set of columns that contains data to uniquely identify each row in a relational database table. For example, each customer must have a unique identifier, possibly a phone number or an internally generated customer number.

Privacy (1) The concept that people should be able to go about their lives without constant surveillance, that personal information about people should not be shared without their permission. (2) Collecting personal data only when you have a legitimate use for it, allowing customers to correct and remove personal data. Protecting confidential data so that it is not released to anyone. Giving customers the option so that you do not sell or lease their personal data.

Private key In a dual-key encryption system, the key that is protected by the owner and never revealed. It is generally a very large number.

Problem boundary The line that identifies the primary components of the system that are creating a specific problem. Subsystems inside the boundary can be modified to solve the problem or enhance the system. Subsystems outside the boundary cannot be altered at this time.

Procedures Instructions that help people use the systems. They include items such as user manuals, documentation, and procedures to ensure that backups are made regularly.

Process An activity that is part of a data flow diagram. Systems can be built to process goods or to process data. Most information system work focuses on processes that alter data.

Process control The use of computers to monitor and control the production machines and robots. Production lines generally use many different machines, each requiring several adjustments or settings. Computer control simplifies and speeds the setup.

Process innovation Evaluating the entire firm to improve individual processes, and to search for integrated solutions that will reduce costs, improve quality or boost sales to gain a competitive advantage. See also reengineering.

Processor The heart of a computer. It carries out the instructions of the operating system and the application programs.

Product differentiation The ability to make your products appear different from those of your rivals, thus attracting more customers. Information systems have been used to alter products and provide new services.

Program logic Writing program code requires defining the steps or logic that the computer should follow to complete a task. A program must also use the correct words, symbols, and punctuation, known as syntax.

Properties See attributes.

Protect document A method of restricting changes to Microsoft Office files. A limited version of information rights management that will allow people to read a document but not make changes.

Protocols A set of definitions and standards that establish the communication links on a network. Networks are often classified by their choice of protocol. Common protocols include Ethernet, Token Ring, and TCP/IP.

Prototyping An iterative system design technique that takes advantage of high-level tools to rapidly create working systems. The main objective of prototyping is to create a working version of the system as quickly as possible, even if some components are not included in the early versions.

Pseudocode A loosely structured method to describe the logic of a program or outline a system. It uses basic programming techniques but ignores issues of syntax and relies on verbal descriptions.

Public key In a dual-key encryption system, the key that is given to the public. Each person wishing to use dual-key encryption must have a different public key. The key works only in tandem with the user's private key.

Pure Internet plays Dot-com firms that have no direct tie to traditional business. Firms that make all their revenue from Internet sales or other Internet firms. A popular concept in 1999, but most pure Internet firms failed in 2000 and 2001.

Query by example (QBE) A visual method of examining data stored in a relational database. You ask questions and examine the data by pointing to tables on the screen and filling in templates.

Query system A method of retrieving data in a DBMS. It generally uses a formal process to pose the questions (1) what columns should be displayed? (2) what conditions are given? (3) what tables are involved? and (4) how are the tables connected? See query by example and SQL.

Radio frequency identification (RFID) Small, passive computer chips that are powered by radio waves. When triggered by a reader, the chip returns data stored in its memory by modulating the radio signals. Readable range is limited to a few feet or less. If price drops far enough, they might replace bar codes.

Random access memory (RAM) High-speed memory chips that hold data for immediate processing. On most computers, data held in RAM is lost when the power is removed, so data must be moved to secondary storage.

Rapid application development (RAD) The goal of building a system much faster than with traditional SDLC methods. Using powerful tools (database management system, high-level languages, graphical toolkits, and objects), highly trained programmers can build systems in a matter of weeks or months. Using workgroups, communication networks, and CASE tools, small teams can speed up the development and design steps.

Read Only Memory (ROM) A type of memory on which data can be stored only one time. It can be read as often as needed but cannot be changed. ROM keeps its data when power is removed, so it is used to hold certain core programs and system data that is rarely changed.

Really simple syndication (RSS) A technique used with blogs to automatically push new versions down to subscribers. Users can configure a Web browser to connect to a favorite blogger. New versions are automatically displayed on the browser.

Reduced instruction set computer (RISC) When designing a RISC processor, the manufacturer deliberately limits the number of circuits and instructions on the chip. The goal is to create a processor that performs a few simple tasks very fast. More complex problems are solved in software. Because RISC processors require fewer circuits, they are easier to produce.

Redundant array of independent Disks (RAID) A system consisting of several smaller drives instead of one large drive. Large files are split into pieces stored on several different physical drives. The data pieces can be duplicated and stored in more than one location for backup. RAID systems also provide faster access to the data, because each of the drives can be searching through their part of the file at the same time.

Reengineering A complete reorganization of a company. Beginning from scratch, you identify goals along with the most efficient means of attaining those goals, and create new processes that change the company to meet the new goals. The term reengineering and its current usage were made popular in 1990 by management consultants James Champy and Michael Hammer.

Relational database A database in which all data is stored in flat tables that meet the normalization rules. Tables are logically connected by matching columns of data. System data—such as access rights, descriptions, and data definition—are also stored in tables.

Repetitive stress injury (RSI) An injury that occurs from repeating a stressful action. For instance, several people have complained that constant typing damages their wrists. Ergonomic design, adjusting your work space, and taking breaks are common recommendations to avoid repetitive stress.

Replay attack If an attacker captures a set of network transmissions, the attacker could replay those same messages by sending them again to gain access to a server or duplicate a financial transaction.

Replication The intentional process of duplicating data in a database so that it can be transported and accessed in multiple locations. The DBMS has the ability to synchronize data changes between the master copy and any replicas.

Report A printed summary or screen display that is produced on a regular basis by a database management system. The main sections of a report are report header, page header, group/break header, detail, group/break footer, page footer, and report footer.

Request for proposal (RFP) A list of specifications and questions sent to vendors asking them to propose (sell) a product that might fill those needs.

Resolution The number of dots or pixels displayed per inch of horizontal or vertical space. Input and output devices, as well as images and video, are measured by their resolution. Higher values of dots per inch yield more detailed images.

Reusability The ultimate goal of object-oriented systems. By defining an object up front and storing it in a repository the object can be used in many applications, instead of requiring developers to recreate it every time a new system is built.

Reverse engineering The process of taking older software and rewriting it to modernize it and make it easier to modify and enhance. Reverse engineering tools consist of software that reads the program code from the original software and converts it to a form that is easier to modify.

RGB Red-green-blue. A color scheme used for video displays. Colors are specified by identifying the desired strength of each primary color. In most implementations the color value ranges from 0 to 255 (one byte). See also CMYK.

Rivals Any group of firms that are competing for customers and sales. Similar to competitors, but "competition" carries an economic definition involving many firms. Even an industry with two firms can experience rivalry.

Rivest-Shamir-Adelman (RSA) Three mathematicians who developed and patented a dual-key encryption system. The term often refers to the encryption technique. It is based on the computational difficulty of factoring very large numbers into their prime components.

Rocket scientists Mathematically trained financial analysts who build complex mathematical models of the stock market and help create and price new securities.

Router A communication device that connects subnetworks together. Local messages remain within each subnetwork. Messages between sub-networks are sent to the proper location through the router.

Row A horizontal element that contains all of the data to describe an entity or object in a relational database or spreadsheet.

Rules A set of conditions that describe a problem or a potential response. Generally expressed as "If… Then" conditions. Used by expert systems to analyze new problems and suggest alternatives.

Sampler An input device that reads electrical signals from a microphone and stores the sound as a collection of numbers. It measures the frequency and amplitude of the sound waves thousands of times per second.

Scalability The ability to buy a faster computer as needed and transfer all software and data without modification. True scalability enables users to buy a smaller computer today and upgrade later without incurring huge conversion costs.

Scope creep The process in any project where people keep trying to add new features to the project. An easy way to drive a project out of control. As the number of features added begins to exceed the original plan, the costs increase and the project is delayed.

Script kiddie A lazy attacker who downloads code from the Internet to attempt to find and exploit known holes. Can be stopped by ensuring your software contains all current patches.

Scrolling region On a data entry form, a subform or section that is designed to collect multiple rows of data. Much like a spreadsheet, the user can move back and forth to alter or examine prior entries.

Search engine optimization A practice of making a Web site more compatible with search engines. The goal is to make the page appear higher in the list of results when users search for the desired topic. Most good SEO techniques define the page precisely so that it matches exactly how a person perceives the page. Black hat or bad SEO methods try to trick the search engine—which usually results in the site being blacklisted by the search engine.

Secondary storage Data storage devices that hold data even if they lose power. Typically cheaper than RAM, but slower. Disk drives are common secondary storage devices.

Secure sockets layer (SSL) A system that provides encryption for Internet transmissions. Commonly used to establish a secure connection between client browsers and e-commerce servers. It is established with dual-key encryption by installing a digital security certificate on the server.

Serifs The small lines, curlicues, and ornamentation on many typefaces. They generally make it easier for people to read words and sentences on printed output. Sans serif typefaces have more white space between characters and are often used for signs and displays that must be read from a longer distance.

Server farm A collection of dozens or hundreds of smaller servers. Software allocates tasks to whichever server is the least busy. This approach to scalability is fault-tolerant and easy to expand, but can be difficult to manage.

Service level agreement (SLA) A formal written agreement between a user group and a service provider that specifies guaranteed levels of service and compensation for failure to meet those levels. SLAs are commonly used in outsourcing deals to ensure the contracted party is providing adequate levels of service, particularly with network providers.

SharePoint Microsoft's Web-based tool for teamwork. It supports file sharing, version control, discussion groups, and surveys.

Sign-off In a systems development life-cycle approach, the approval that managers must give to forms, reports, and computations at various stages of the development. This approval is given when they sign the appropriate documents.

Simple object access protocol (SOAP) A standard, easy-to-implement method of exchanging information and messages among different computers on the Internet. A protocol that works with XML to support Web-based services.

Simulation Models are used to examine what might happen if we decide to make changes to the process, to see how the system will react to external events, or to examine relationships in more detail.

Single sign-on A comprehensive security authentication system so that users can log in (sign on) one time. Once the user's identity has been established, all applications obtain the credentials from a central server to recognize the user and determine access rights.

Social engineering A method used by attackers to obtain usernames and passwords to obtain illegal access to a system. An attacker might call a user and pretend to be a system administrator asking for confirmation of a password. Relatively easy to stop by never telling your password to anyone. Systems administrators will never need your password.

Social legitimacy At one time, mainstream organizations were identified by the quality of their presentation and their image. Large firms spend millions of dollars on graphic artists, professional designers, and professional printing. The decreasing cost of computers enables even small organizations to create an image that is hard to distinguish from large organizations.

Social networking Contacts with friends and businesspeople. Many Web sites such as Facebook, Flickr, and YouTube were built to support social networking—enabling users to find each other and share information online.

Software A collection of computer programs that are algorithms or logical statements that control the hardware.

Software as a service (SaaS) Selling software for usage or monthly fees instead of charging a fixed upfront price. Easiest to implement with cloud computing but it can also be done with in-house software. Upgrades and maintenance are typically included in the price and sometimes the maintenance work is handled by the developing company.

Software maintenance The act of fixing problems, altering reports, or extending an existing system to improve it. It refers to changes in the software, not to hardware tasks such as cleaning printers.

Software piracy The act of copying software without paying the copyright owner. With few exceptions (e.g., backup), copying software is illegal. Companies and individuals who are caught have to pay thousands of dollars in penalties and risk going to jail. It is commonly accepted that piracy takes money away from the development of improved software.

Software suites Collections of software packages that are designed to operate together. Theoretically, data from each package can be easily shared with data from the others. So word processors can incorporate graphics, and spreadsheets can retrieve data from the database management system. Suites are often sold at a substantial discount compared to buying each package separately.

Solid state drive A disk drive replacement or data storage mechanism that uses electronic components to store data instead of a movable platter. Most SSDs are similar to flash drives but with greater capacity and faster data transfer speeds.

Sound One of the basic data types. There are two methods to describe sound: samples or MIDI. Digitized (sampled) sound is based on a specified sampling and playback rate, and fits into frequency and amplitude (volume) ranges.

Spam Unsolicited commercial e-mail, or junk mail. Unwanted messages sent by commercial entities or hackers trying to steal your system or your money. It makes up over 50 percent of e-mail traffic. Most nations have made it illegal, but it is hard to stop. The name refers to a Hormel meat product, but its use is often attributed to a Monty Python sketch.

Speech recognition The ability of a computer to capture spoken words, convert them into text, and then take some action based on the command.

Spyware Software that stealthily installs itself on your computer, records your activities or keystrokes. Commonly used by attackers who collect the data to learn your account passwords. Extremely dangerous because once installed it can gain total access to your system. Software scanning tools can spot most common spyware programs. Windows Vista has other tools to prevent programs from installing themselves without your knowledge.

SQL A structured query language supported by most major database management systems. The most common command is of the form: SELECT column list FROM table list JOIN how tables are related WHERE condition ORDER BY columns.

Standard operating procedures A set of procedures that define how employees and managers should deal with certain situations.

Standards An agreement that specifies certain technical definitions. Standards can be established by committees or evolve over time through market pressures. As technology changes, new standards are created.

Static HTML Simple HTML pages that are changed only by humans, so they are rarely changed. Generally used only for the prepurchase information stage of e-commerce.

Static integration A means of combining data from two documents. A copy of the original is placed into the new document. Because it is static, changes made to the original document are not automatically updated. See also dynamic integration.

Statistical quality control (SQC) The statistical analysis of measurement data to improve quality. Several statistical calculations and graphs are used to determine whether fluctuations are purely random or represent major changes that need to be corrected.

Stock options A right to purchase a specific stock at a given price. Often granted to workers and managers in start-up companies. If the company grows rapidly, its stock price should increase. The option owner can cash in the options and receive the difference between the current price and the option price.

Storage area network (SAN) A method of storing computer data on devices attached to a high-speed local connection instead of placing them into each computer. Separating data from the computer and centralizing it makes it easier to upgrade, control, and provide backups. Fiber optic connections are often used for SAN drives.

Strategic decisions Decisions that involve changing the overall structure of the firm. They are long-term decisions and are unstructured. They represent an attempt to gain a competitive advantage over your rivals. They are usually difficult and risky decisions. MIS support for strategic decisions typically consists of gathering, analyzing, and presenting data on rivals, customers, and suppliers.

Structured decisions Decisions that can be defined by a set of rules or procedures. They can be highly detailed, but they are defined without resorting to vague definitions.

Structured walkthrough A review process in which the objective is to reveal problems, inaccuracies, ambiguities, and omissions in the system's design before the program code is finalized. The users are presented with a prototype or mockup of the proposed system.

Subchapter S corporation A legal variation of a corporation that can be chosen by the owners. The IRS and some states impose limits on the type of company that can elect this option. It avoids the problem of double taxation by passing income and losses directly to the owners' personal income tax statements.

Supply chain management (SCM) Organizing the entire supply process including vendor selection, parts management, ordering, tracking, payment, and quality control.

Switch A network device used to connect machines. Unlike a router, a switch creates a virtual circuit that is used by a single machine at a time.

Switching costs The costs incurred in creating a similar information system when a customer switches to a rival firm. Information technology creates switching costs because customers would have to convert data, re-create reports, and retrain users.

Synchronization A method of sending data from multiple computers to provide up-to-date data on both computers. Data changes are sent to each computer participating in the synchronization process to ensure each participant has the same set of data.

Syntax The set of command words, symbols, and punctuation used by a computer programming language. When writing programs, you must type the exact words and symbols so the computer understands what you want it to do. See also programming logic.

Synthesizer An electronic device to convert electrical signals into sound. One basic technique is FM synthesis, which generates and combines fixed waves to achieve the desired sound. A newer method combines short digitized samples of various instruments with waveforms to create more realistic sounds.

Sysop System operator. Person in charge of an electronic bulletin board who organizes files and controls access and privileges.

System A collection of interrelated objects that work toward some goal.

Systems analysis and design A refinement of the scientific method that is used to analyze and build information systems.

Systems analyst A common job in MIS. The analyst is responsible for designing new systems. Analysts must understand the business application and be able to communicate with users. Analysts must also understand technical specifications and programming details.

Systems development life cycle (SDLC) A formal method of designing and building information systems. There are five basic phases: (1) feasibility and planning, (2) systems analysis, (3) systems design, (4) implementation, and (5) maintenance and review.

T1, T3 An older communication link provided by phone companies. Used to carry digitized analog signals, it is being replaced with ISDN links. T1 refers to a group of 24 voice-grade lines and can carry 1.544 megabits per second (Mbps). A T2 trunk line is equivalent to 96 voice circuits providing 6.312 Mbps. T3 provides 44.736 Mbps, and T4 can carry 139,264 Mbps. Services can be leased at any of these levels, where greater bandwidth carries higher costs.

Table A method of storing data in a relational database. Tables contain data for one entity or object. The columns represent attributes, and data for each item is stored in a single row. Each table must have a primary key.

Tactical decisions Tactical decisions typically involve time frames of less than a year. They usually result in making relatively major changes to operations but staying within the existing structure of the organization. MIS support consists of databases, networks, integration, decision support systems, and expert systems.

Telnet A method supported on the Internet that enables users of one computer to log on to a different computer. Once logged on to the new system, the user is treated as any other user on the system.

Table The basic method of storing data in a DBMS. Each table represents one object or entity. Relational databases require that tables be defined following specific data normalization rules.

Tebibyte The new IEC definition for trillion in base 2 (2^{40}). It replaces terabyte which is to be used for decimal numbers. Denoted with TiB.

Telepresence A large, high-resolution video conferencing system that has the goal of providing a distance meeting as comfortable as in person.

Template A method of creating objects such as forms, reports, and Web sites to ensure that they follow the same format. A designer creates a template and all objects follow those design standards.

Terabyte Approximately 1 trillion bytes of data. Technically, it is 2 to the 40th power or 1024*1024*1024*1024 (4 times). The step lower is gigabyte, the step above is petabyte.

Text The simplest of the four basic data types, it also includes numbers. In its most basic form, text is made up of individual characters, which are stored in the computer as numbers. More sophisticated text is described by its typeface, font size, color, and orientation (rotation).

Thin client Simpler hardware than a full-blown personal computer, with minimal software. It is generally used to display applications running on the server and to accept input from the user.

Time division multiplexing (TDM) A method of sharing a communication medium with multiple users where each computer is allowed to send data for a specified amount of time, then releases it to the next computer. Typically handled by requiring devices to send short packets of data.

Token Ring A communications protocol that describes when each machine can send messages. A machine can transmit only when it receives a special message called a token. When the message is finished or a time limit is reached, the token is passed to the next machine.

Top-down development An approach to designing and building systems that begins with an analysis of the entire company and works down to increasing detail. A complete top-down approach is usually impossible because it takes too long to analyze everything. See also bottom-up development.

Total cost of ownership (TCO) The cost of purchasing and running a client computer (personal computer). A highly subjective number, it typically includes the hardware cost, the software license fees, maintenance costs, and training costs.

Total quality management (TQM) A management doctrine stating that quality must be built into every process and item. Every step and each person must be dedicated to producing quality products and services.

Track changes A method in Microsoft Word that highlights the changes made by each person. The original author can then choose to accept or reject each change. A useful groupware tool when several people need to cooperate on writing a document.

Transaction-processing system A system that records and collects data related to exchanges between two parties. This data forms the foundation for all other information system capabilities. MIS support typically consists of databases, communication networks, and security controls.

Transborder data flow (TBDF) The transfer of data across national boundaries. Some countries place restrictions on the transfer of data, especially data that relates to citizens (and, of course, data related to "national security"). Some people have discussed taxing the flow of data.

Transmission medium The physical method of connecting communication devices. The most common media in use are electrical wires, fiber optics, and radio or micro waves.

Triggered rule In an expert system, if a rule is used in an application, it is said to have been triggered or fired.

Trojan Horse A special program that hides inside another program. Eventually, when the main program is run, the Trojan Horse program might delete files, display a message, or copy data to an external computer.

True color Humans can distinguish about 16 million colors. Devices that can display that many colors are said to display true color. It requires the device to use 3 bytes (24 bits) for each pixel.

Turing test A test proposed by Alan Turing in which a machine would be judged "intelligent" if the software could use conversation to fool a human into thinking it was talking with a person instead of a machine.

Turn-key systems Computer application systems designed for a specific task that can be installed easily. Common examples include applications for specific types of businesses, such as a system for physicians or dentists.

Twisted-pair cable Common dual-line wire. Often packaged as three or four pairs of wires. The cable can be run for only a limited distance, and the signal is subject to interference.

Two-factor authentication A login process that requires two types of systems for identifying users. The most common examples are: (1) username/password, and (2) a generator card that creates a random number every minute that is synchronized to the central computer.

Typeface A defined way to draw a set of text characters. Several thousand typefaces have been created to meet different artistic and communication needs. A common characterization is serif and sans serif typefaces.

Ultra-wideband (UWB) A wireless communication protocol that is radically different from other wireless systems. Designed for short range, the system uses very low power but very high frequency bandwidth. The low power enables it to be invisible to existing applications, so it can use large amounts of bandwidth to send multiple bits of data at the same time—transmitting in parallel form it can quickly send large files. Proposed as a replacement for physical connection cables, particularly video connectors.

Unicode An international standard that defines character sets for every modern (living) language and many extinct languages (e.g., Latin).

Uninterruptable power supply (UPS) A large battery and special circuitry that provide a buffer between the computer and the power supply. It protects the computer from spikes and brownouts.

Universal description, discovery, and integration (UDDI) A public Web-based directory system designed to enable computers to find and use Web services offered by other companies. For example, someday your computer could automatically find all companies that can use current exchange rates to convert prices.

UNIX A popular operating system created by Bell Labs. It is designed to operate the same on hardware from several different vendors. Unfortunately, there are several varieties of UNIX, and software that operates on one version often must be modified to function on other machines.

Unstable model A model that cannot be solved for a single solution. The solution might continually diverge, or it could oscillate between several alternatives, generally due to insufficient or incorrect feedback mechanisms.

Upload To transfer files from a local computer (usually a personal computer) to a distant computer. See also download.

Usenet See newsgroups.

User resistance People often resist change. Implementation of a new system highlights this resistance. Managers and developers must prepare for this resistance and encourage users to change. Education and training are common techniques.

Value chain A description of the many steps involved in creating a product or service. Each step adds value to the product or service. Managers need to evaluate the chain to find opportunities to expand the firm and gain more sales and profits.

Vector image A stored collection of mathematical equations, representing lines, circles, and points. These equations can be rescaled to fit any output device or to any desired size. Users deal with the base objects, not the mathematical definitions.

Venture capital Money offered by specialized firms to start up companies. Banks rarely give money to start-ups, so venture capitalists finance risky ventures in the hope of high profits when the company goes public. Many strings can be attached to the money—including a loss of control.

Version control Software that tracks changes made to other documents. Often used in software development to enable developers to go back to prior version. It is also available for common business documents and files. A limited version is embedded into Microsoft Word.

Video One of the basic data types. Video combines the attributes of images and sound. An important attribute is the frames per second definition. U.S. standard video operates at 30 frames per second, movie films run at 24 frames per second. Digitizing video requires capturing and playing back the frames at the appropriate speed.

Videoconference A meeting tool that transmits images and sound of at least one participant. Often, video cameras are available to everyone involved in the conference. High-end systems enable the participants to control the cameras.

View A stored query. If you have a complex query that you have to run every week, you (or a database specialist) could create the query and save it as a view with its own name. It is then treated much like a simple table.

Virtual machine (VM) A software-based definition of a computer that is stored and run on top of a physical computer. A single physical computer can host several VMs. Physical processors, RAM, disk space, and network connections are shared among the VMs. Generally, the physical elements can be reallocated to whichever VM currently needs more capacity.

Virtual mall A collection of Web-based merchants who join together for marketing purposes. Generally they share a common Web host and the same commerce server software. By sharing costs, they can survive without a huge amount of sales.

Virtual private network (VPN) Software installed on a company network and on each client that automatically encrypts all communications between the two; useful when workers travel or need to reach the company servers from home using the Internet.

Virtual reality (VR) Virtual reality describes computer displays and techniques that are designed to provide a realistic image to user senses, including three-dimensional video, three-dimensional sound, and sensors that detect user movement that is translated to on-screen action.

Virus A malicious program that hides inside another program. As the main program runs, the virus copies itself into other programs. At some point, the virus displays a message, shuts down the machine, or deletes all of the files.

Visual Basic A modern variation of the BASIC programming language created by Microsoft for application programming in Windows. A variation resides inside many of the Microsoft applications, enabling programmers to manipulate and exchange data among the database, spreadsheet, and word processor.

Visual table of contents A graphical design method that shows how modules of a system are related. Versions of the technique are also used to display menu trees.

Voice mail A messaging system similar to telephone answering machines but with additional features like message store and forward. You can use your computer to send messages to coworkers. There are tools that will read e-mail and fax messages over the phone, so managers can stay in touch while they are away from the computer.

Voice over Internet protocol (VoIP) Connecting telephones to the network and using the Internet to transfer phone conversations—instead of traditional phone lines.

Voice recognition The ability of a computer to capture spoken words and convert them into text.

Web 2.0 A second generation of Web sites—dedicated to providing shared services such as the social networking sites. The term is not precisely defined and people disagree on what to include, but it excludes first-generation text and EC sales sites.

Webmaster Specialized IS worker who is responsible for creating, maintaining, and revising a company's World Wide Web site. Webmasters use technical and artistic skills to create sites that attract browsers.

Whois A utility supported by some operating systems and the network registrars to provide information about the ownership of domain names and Internet access connections. Unfortunately, many people lie (illegally) when they fill out the required information.

Wide area network (WAN) A network that is spread across a larger geographic area. In most cases, parts of the network are outside the control of a single firm. Long-distance connections often use public carriers.

WiFi Short for wireless fidelity. An early protocol for defining wireless connections, commonly used in homes and businesses. It has a relatively short range (perhaps 100 meters). Transfer speeds initially were less than 11 mbps (using 802.11b), but have increased to 54 mbps (802.11a and 802.11g), and are potentially up to 100 or 200 mbps (802.11n). The higher speeds are achieved by using multiple frequencies at the same time. Actual speeds are considerably lower (as low as half the rated maximum).

Wiki A Web site designed to enable multiple people to create and revise content. The most famous is Wikipedia where anyone can create encyclopedic entries. The tools can be used for business teamwork applications.

Wi-Max A wireless technology designed for relatively high speeds and medium distances—

up to several kilometers. It can support point-to-point transmissions to create high-speed Internet connections to service providers, or multipoint systems to handle many users at the same time. Clearwire and Sprint led the way at installing the technology in the U.S. and joined forces in 2007.

Window A portion of the computer screen. You can move each window or change its size. Windows enable you to display and use several applications on the screen at one time.

Wisdom A level above knowledge. Wisdom represents intelligence, or the ability to analyze, learn, adapt to changing conditions, and create knowledge.

Workflow software A type of groupware that is designed to automate forms handling and the flow of data in a company. Forms and reports are automatically routed to a list of users on the network. When each person adds comments or makes changes, it is routed to the next process.

Workstations Computers attached to a network, designed for individual use. Typically, personal computers.

World Wide Web (WWW) A first attempt to set up an international database of information. Web browsers display graphical pages of information, including pictures. Hypertext connections enable you to get related information by clicking highlighted words.

WYSIWYG What you see is what you get. With a true WYSIWYG system, documents will look exactly the same on the screen as they do when printed. In addition to format, it means that the printer must have the same typefaces as the video display. Color printers use a system to match the colors on the monitor.

Zebibyte The IEC term for binary counting with the value 270. It replaces zettabyte, which is to be used for decimal-based counting.

Zero-day attacks Attacks on computers that are based on flaws found in software that have not yet been patched. The zero-day means attackers found the flaw before or simultaneously with security researchers.

Zettabyte In the IEC definition, it is the decimal base number 1021. It falls above zettabyte and below yottabyte. The binary version is called zebibyte.

zShops Amazon.com offers small companies a relatively inexpensive e-commerce solution with little or no fixed costs. Useful for small firms, the system provides marketing, visibility, and a payment mechanism. Amazon more commonly refers to Marketplace shops, but zShops was the original title. By 2010 it was renamed to the Webstore.

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