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?

ExxonMobile

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-

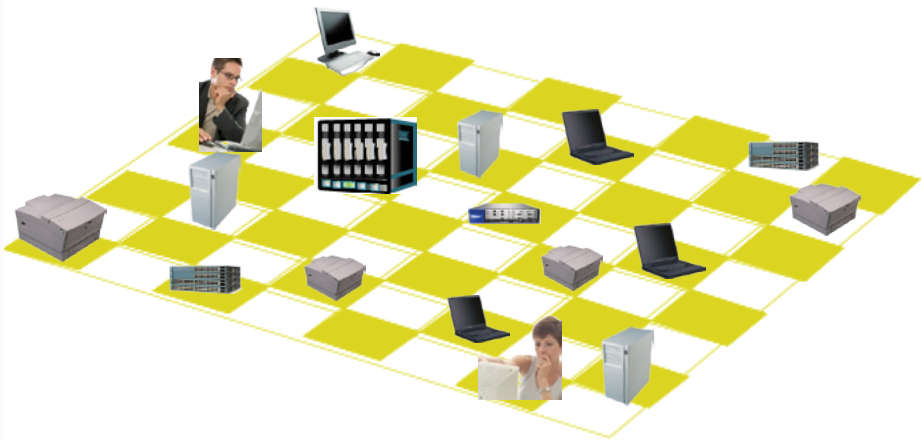

Figure 13.1

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

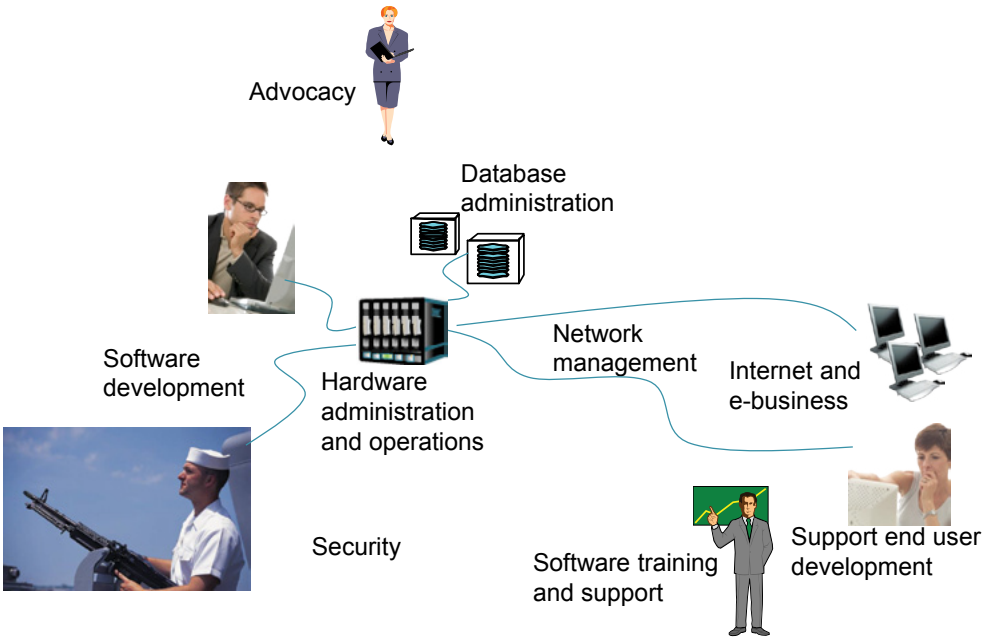

Figure 13.2

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

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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 com-

petitors. 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.

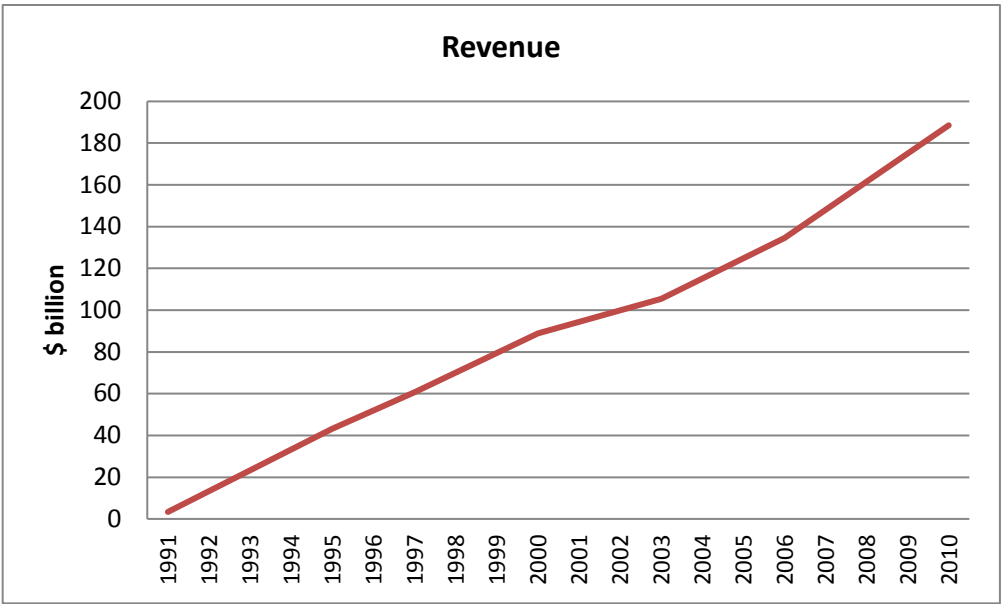


Figure 13.7

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 underinvested 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-

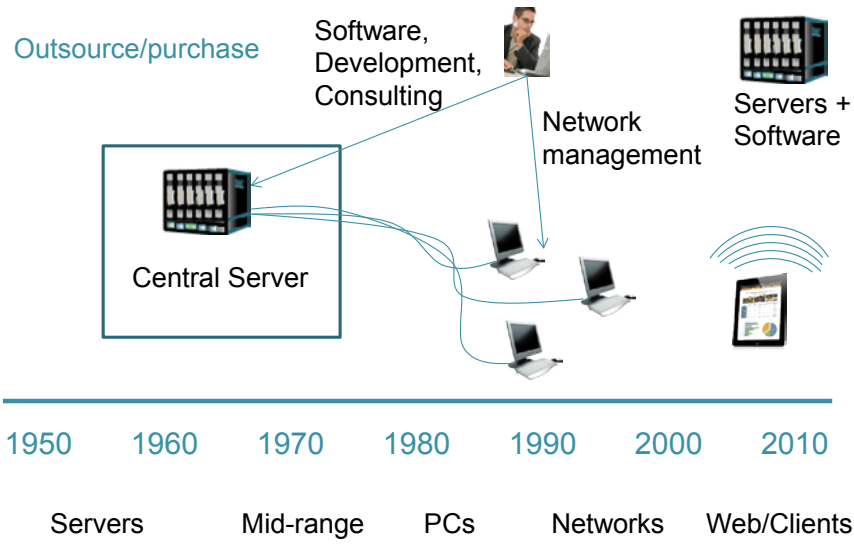


Figure 13.9

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 microcomputers 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.

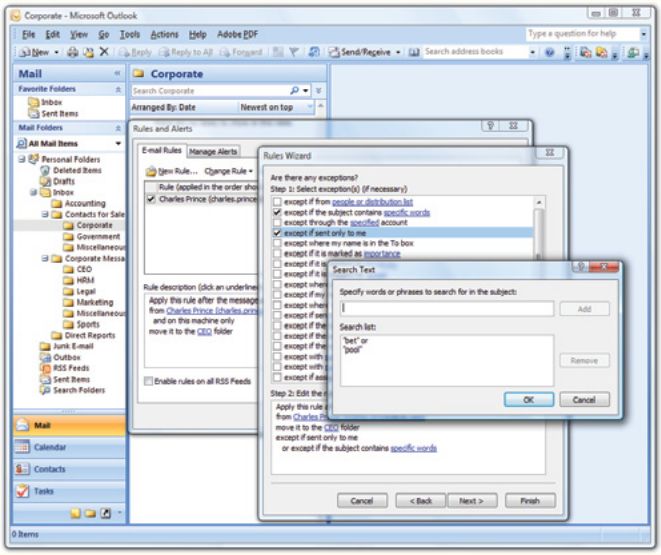
clining sizes and prices of technology, and (2) expanding access to the Internet—particularly wireless connections. Internet sites are slowly becoming repositories of information that is accessible any time from almost any location. External data on the economy, news, financial markets, consumers, competitors, 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.

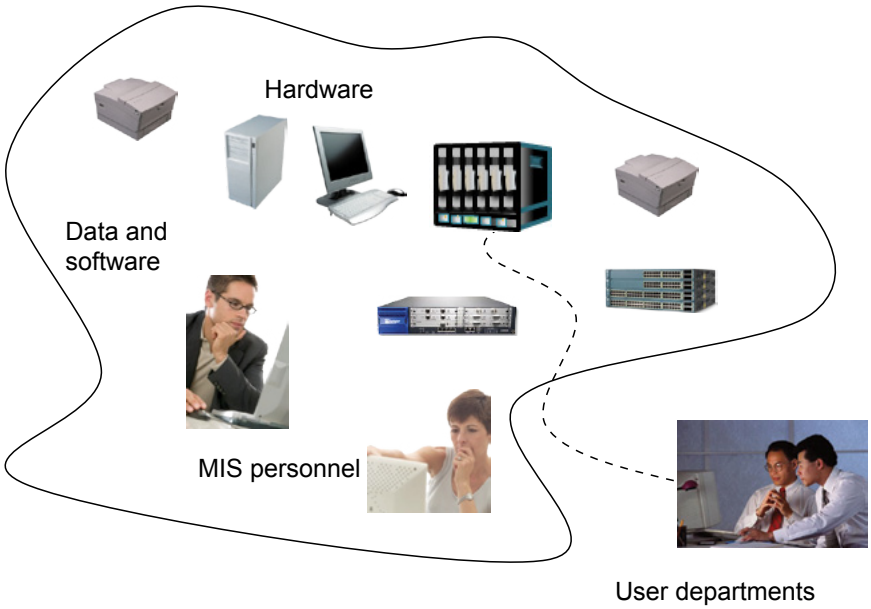


Figure 13.11

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.

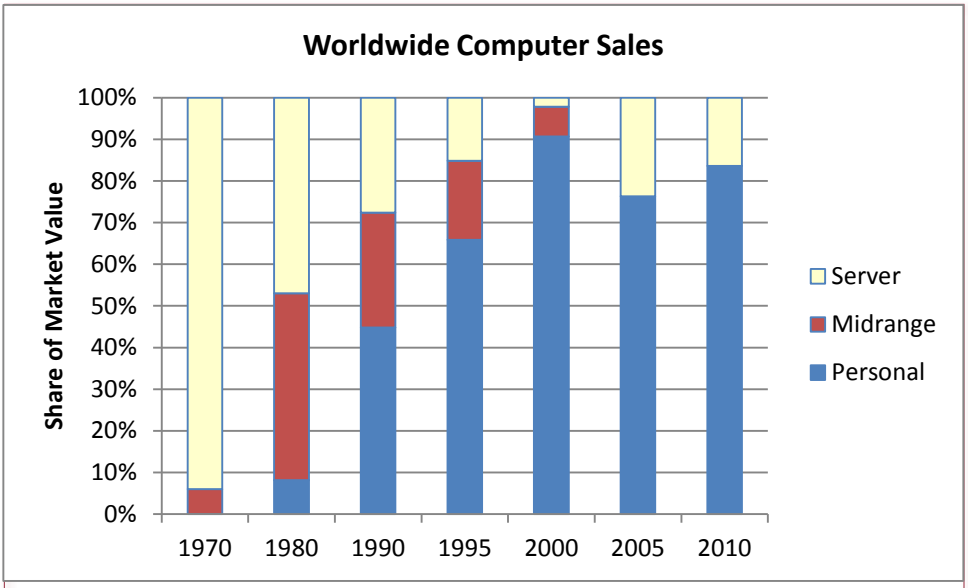


Figure 13.12

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

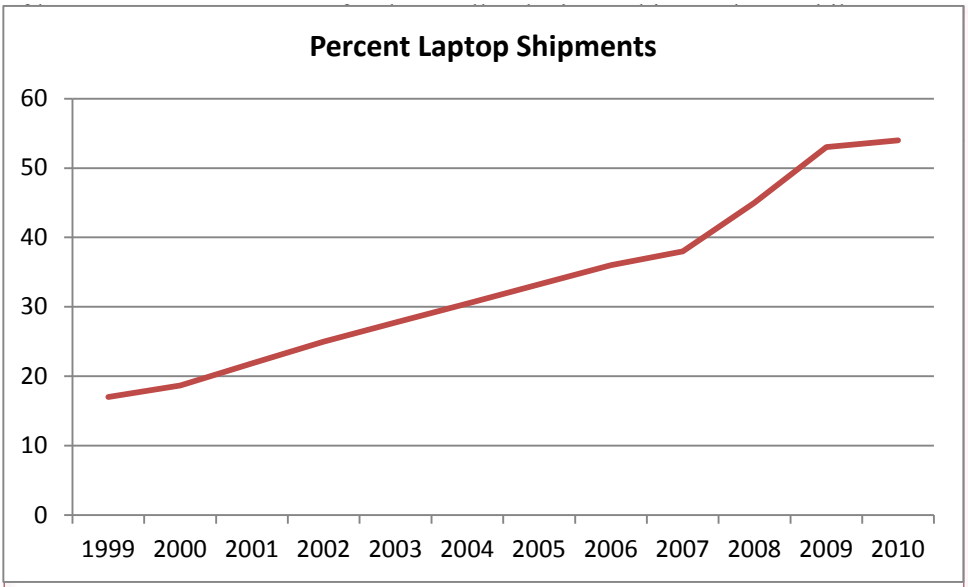


Figure 13.13

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.

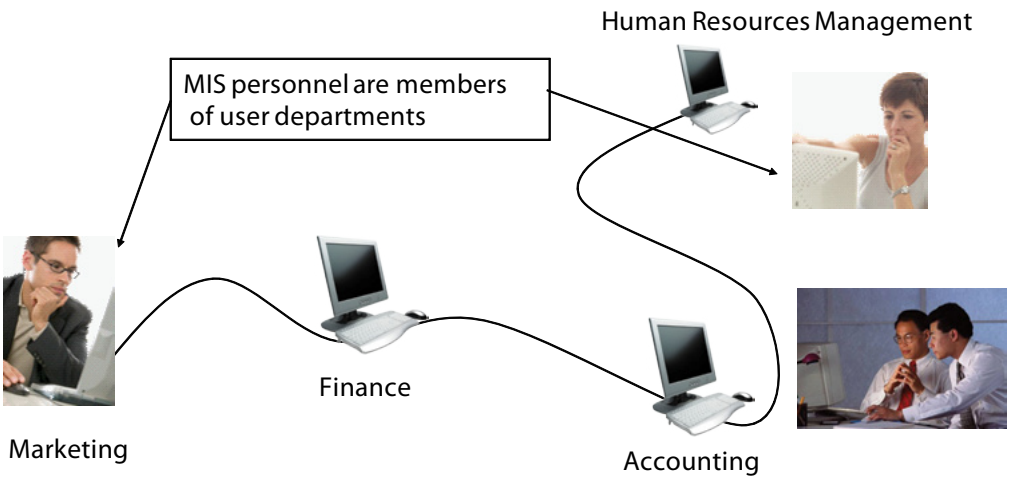


Figure 13.14

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

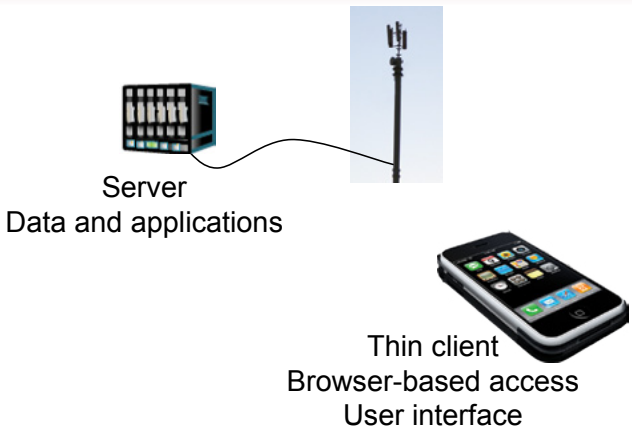


Figure 13.15

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.

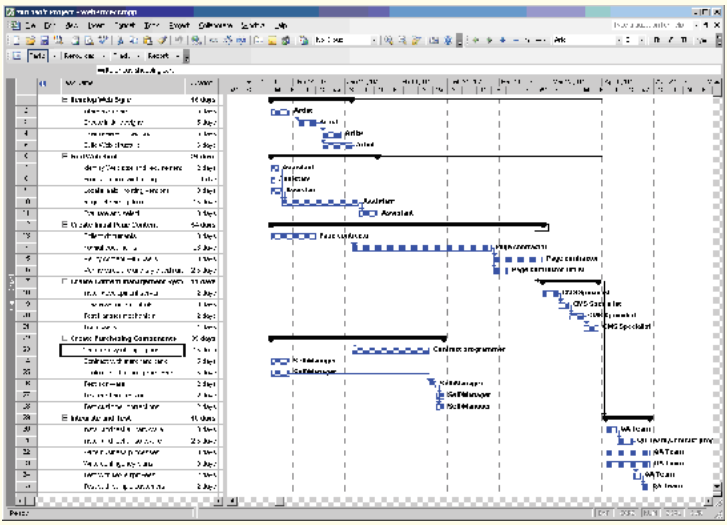
The capabilities of the Internet browser have led firms to consider a new approach to organizing the MIS resources. The **thin-client** approach, illustrated in Figure 13.15, uses a relatively simple computer to run a Web browser that is responsible for displaying data and getting input from the user. 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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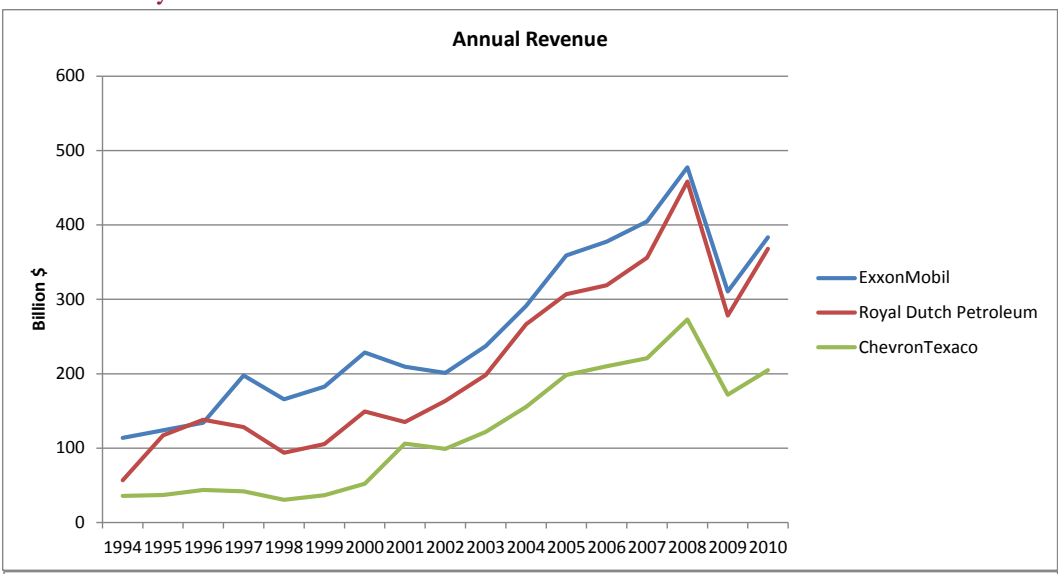
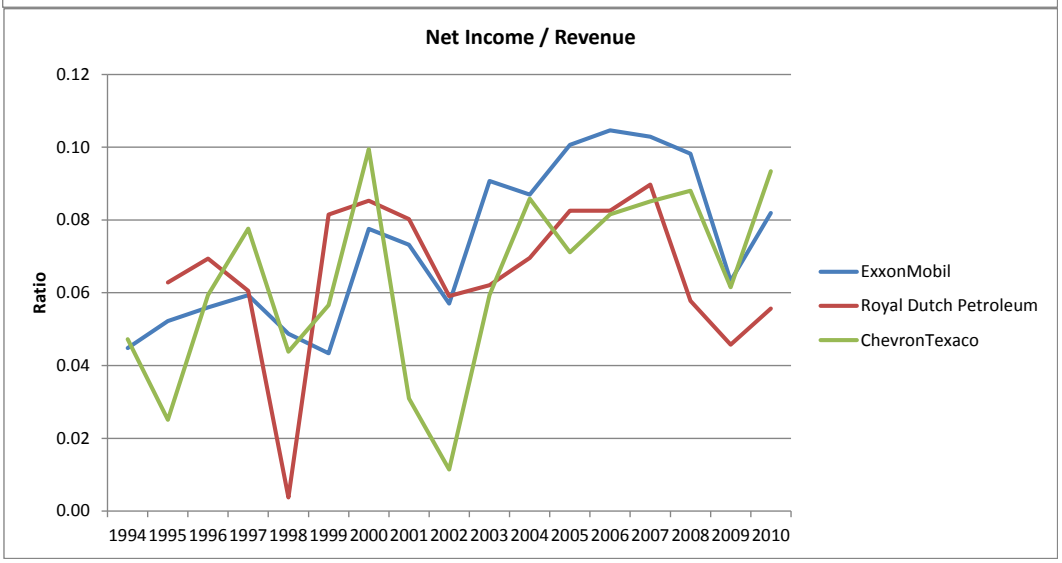
Cases: The Energy Industry

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 produc-

tion 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.

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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?