Chapter 6

Transactions and Enterprise Resource Planning

Chapter Outline

What You Will Learn in This Chapter

- How do you process the data from transactions and integrate the operations of the organization?
- How do you efficiently collect transaction data?
- What are the major elements and risks of a transaction?
- Why are transactions more difficult in an international environment?
- How do you track and compare the financial information of a firm?
- What are the transaction elements in the human resources management system?
- Can a company become more efficient and productive?
- How do businesses combine data from operations?
- How do you combine data across functional areas, including production, purchasing, marketing, and accounting?
- How do you make production more efficient?
- How do you keep track of all customer interactions? Who are your best customers?
- How can a manager handle all of the data in an ERP system?
- How does the CEO know that financial records are correct?
- Why do most companies avoid cloud computing for ERP systems?

Ford Motor Company

How do you manage a huge organization? How can you integrate data from hundreds of divisions scattered around the world? Bill Ford, great-grandson of Henry, turned around the struggling manufacturer in the early 2000s. Along the way, he made an amazing discovery: it is more important to sell vehicles at a profit, instead of trying to just sell more at any cost. With hundreds of facilities, Ford, like the other automobile manufacturers, has an immense job of ordering parts, keeping factories scheduled, identifying cars and features that customers actually want, tracking production, monitoring sales, and designing for the future. Having pioneered the mass-production systems of the 1900s, Ford is only now learning to build a more flexible manufacturing system—where one plant can produce different car makes. Information technology plays a key role in making the factories and the entire operation more efficient.

Although the company is publicly held, the family exerts significant influence on it. After former chairman and CEO Donald Petersen rubbed the family the wrong way, he retired prematurely. Alex Trotman took the position in 1995 and hoped to retain the Ford family support. On January 1, 1999, the disappointed Ford family replaced Trotman as CEO with Jacques Nasser. Nasser came from the international side of Ford, which was experiencing strong sales. In 2001, a series of crises, capped by the Firestone tire recall on the Explorer led to high tensions in Ford and in the industry. On October 29, 2001, Bill Ford, Jr., fired Jacques Nasser and installed himself as CEO. On September 5, 2006, the company replaced Bill Ford with Alan Mulally from Boeing.

Figure 6.1

Transactions and Enterprise Resource Planning Integration. The goal is to collect all operations data and share it throughout the organization. Links to suppliers and banks improve integration and provide more options for the firm.

Introduction

How do you process the data from transactions and integrate the operations of the organization? This question has been asked repeatedly for centuries. In fact, it has driven the organizational structure of companies. What were firms like in the 1800s or earlier? Most were small proprietorships. As firms became larger, how could they handle the thousands of daily transactions? Hierarchical structures evolved to collect data at the point of sale, summarize it, and move it up the chain of command to the CEO. Figure 6.1 shows how transactional data is exchanged with customers, suppliers, manufacturing, and banks, and summarized for higher-level decisions. Think about the problems that arise if groups within the company (accounting, production, marketing, and so on) all have different databases. When you have computers today that can capture all of the operations data automatically, do you still need a hierarchical structure? Instead, an integrated system running on a database can be used to share data with everyone.

Whenever two people make an exchange, it is called a transaction. Transactions are important events for a company, and collecting data about them is called **transaction processing**. Examples of transactions include making a purchase at a store, withdrawing money from a checking account, making a payment to a creditor, or paying an employee.

Because of the importance of transactions, companies built systems to track the various aspects, including accounting, human resources, and production. As computer hardware, software, and database technology improved, it because clear that companies needed integrated systems that held all of the data or enterprise-level systems. These tools are complex, but can collect data on all aspects of the organization, including access for employees, managers, customers, and suppliers. The

Trends

Because of legal ramifications, businesses have always collected data about transactions. Accounting systems play an important role in collecting and analyzing transaction data. Through the 1960s, most business computers were primarily producing basic accounting reports. Raw data was punched into the computer by hand, and the computer produced totals and updated the general ledger. In effect, the computer was used as a giant calculator to automate the production of printed reports similar to those used before the advent of computers. The primary reason for using the computer was speed and accuracy. It was justified because it was cheaper and less error-prone than hiring thousands of people to produce the reports.

As computer capabilities increased in the 1970s, the most important change was to use the computer to collect the raw data. In retail sales, the cash register was replaced with a computer terminal and a bar code scanner. Whenever a customer purchased an item, the transaction data was immediately sent to the main computer. This automation eliminated the need to hire a person to enter the data at the end of the day.

The 1980s and 1990s resulted in more integration. Transaction data was made available to managers throughout the company. One goal was to combine the systems across the company into an enterprise system that enabled managers to examine all aspects of the business.

By the late 1990s, integrated systems could support data for the entire organization. Accounting packages handle all accounting information tasks, HRM systems handle employee-related chores, and manufacturing systems deal with production. These enterprise-level systems were designed from the ground up to handle all of the major information tasks of a company. Beyond simple access to data, integrated systems make it possible to change the way the company operate.

integration of data from all areas of the organization from marketing, production, human resources, and accounting leads to new methods of doing business.

Data Capture

How do you efficiently collect transaction data? The basic components of a transaction-processing system are illustrated in Figure 6.2. The focus is twofold: accomplishing the transaction and capturing data. Data capture consists of gathering or acquiring data from the firm's operations and storing data in the computer system. Entering data into the computer can be time consuming and difficult. For instance, banks have invested heavily in automating the collection and recording of transaction data. Yet because many transactions are based on paper, clerks still spend considerable time entering data. First, tellers enter the data into their terminals. Then a bank staff reads the dollar value written on checks and deposit slips. The bank staff works through the night, typing the amount into a machine that codes the number on the bottom of the check so it can be read by other computers.

As the volume of transactions increased, businesses looked for faster and more accurate ways to get data into the computer. Four basic methods are used to collect data, depending on its source. The data-collection method consumers are most

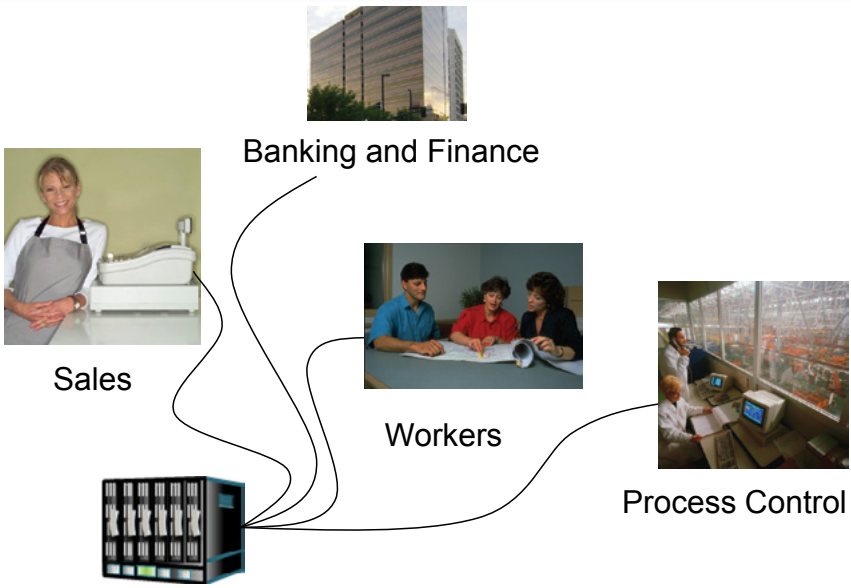


Figure 6.2

Data should be captured as soon as it is generated. The operations level generates data from many sources. Modern systems collect the data in a central database and make it immediately accessible to managers.

familiar with is **point of sale (POS)**, where the sales register is actually a computer terminal that sends all data to a central computer. On assembly lines, robots and manufacturing equipment can collect data, such as quality control measures, and return it to a computer. Typically the computer also can send control instructions to these machines. This exchange of data between manufacturing machines and computers is known as **process control**. The third way to collect data automatically involves the exchange of information with organizations outside the firm, especially suppliers and customers. Instead of dealing with paper records such as purchase orders, it is possible to send orders electronically through a process called **electronic data interchange (EDI)**. The fourth method is to have the customers select products and enter data directly into the electronic commerce Web site. This fourth method offers the potential of reducing errors and costs—if the Web sites are built carefully and if the customers are motivated and capable of selecting the products themselves.

Point of Sale

Several devices have been created to capture data at the point of the sale. Some companies rely on keyboards to enter data, but high-volume areas have switched to bar code scanners. All consumers are familiar with bar code scanners that read the universal product codes (UPCs). The scanner reads the code and sends it to the computer, which looks up the corresponding name and price. The computer prints the receipt, stores the sale information, and automatically decreases the inventory count.

Reality Bytes: Pay By Phone

In 2011, several companies began a push to find a mechanism to use cell phones to make everyday payments. The catch is that several technologies are available, but no one can agree on which method to use. As Omar Green from Intuit points out, "There's a lot of money at stake if it's done right." Some examples include Starbucks, which has an application to display a pre-loaded Starbucks card on a smart phone that the cashier can scan. The Bump application can transfer PayPal cash from one phone to another. Laura Champers of PayPal noted that the company processed $700 million in mobile payments in 2010—a tiny fraction of the $70 billion it handles in total. FourSquare also offers methods to transfer money to other phones. But, none of them are likely to be adopted by typical retail vendors. Instead, the credit card companies are trying to extend their reach through Near Field Communication (NFC) which uses a chip similar to RFID with a shorter range. Put the credit card number on a chip and put the NFC chip into a cell phone and customers can wave the phone in front of a scanner. It is really just a credit card in a different format and could be handled by taping a card to the back of a phone. The main wireless carriers (Verizon Wireless, AT&T, and T-Mobile) also are trying to get into the game by creating the Isis network to work with Discover Financial. Some of the largest banking companies have also been working on alternatives. But, without the support of the credit card companies, it is likely to be difficult to gain any traction with retail stores.

Adapted from Laurie Segall, "Your Mobile Phone is Becoming Your Wallet," *CNN Online*, January 19, 2011.

Another type of scanner is used by the U.S. Postal System—**optical character recognition (OCR)**–to read handwritten zip codes, allowing mail to be processed and sorted faster. Even so, the post office hires thousands of workers to type in data that the scanners cannot read. Banks use a process called **magnetic ink character recognition (MICR)** to process checks and deposit slips. MICR readers are more accurate than straight OCR because they pick up a stronger signal from magnetic particles in the ink. A few companies are using speech recognition technology to enable workers to enter data by speaking to the computer. Speech recognition enables the users to enter data while leaving their hands free to do something else.

The newest data-acquisition technology is **radio frequency identification (RFID)**. Bar codes have two major limitations: (1) they hold a limited amount of data, and (2) even the best scanners have trouble reading them. Basic bar codes can hold 10 digits, but 5 of those are used to identify the manufacturing company, which leaves only 5 digits for the actual product. As a consumer, you have certainly encountered bar codes that are difficult to read. RFIDs are small chips about the size of a grain of rice that consist of an antenna and some transistors. When the scanner sends a radio signal to the chip, the antenna receives it and uses the radio waves to power the transistors and return the stored data by modifying the scanner wave. For several years, people have implanted the chips in their dogs in case the pet becomes lost and loses his or her collar. The capacity and range of RFID chips depend on the frequency (low, high, or ultra-high). The ultra-high frequency chips can be read from the greatest distance (12 feet with a maximum of 40)

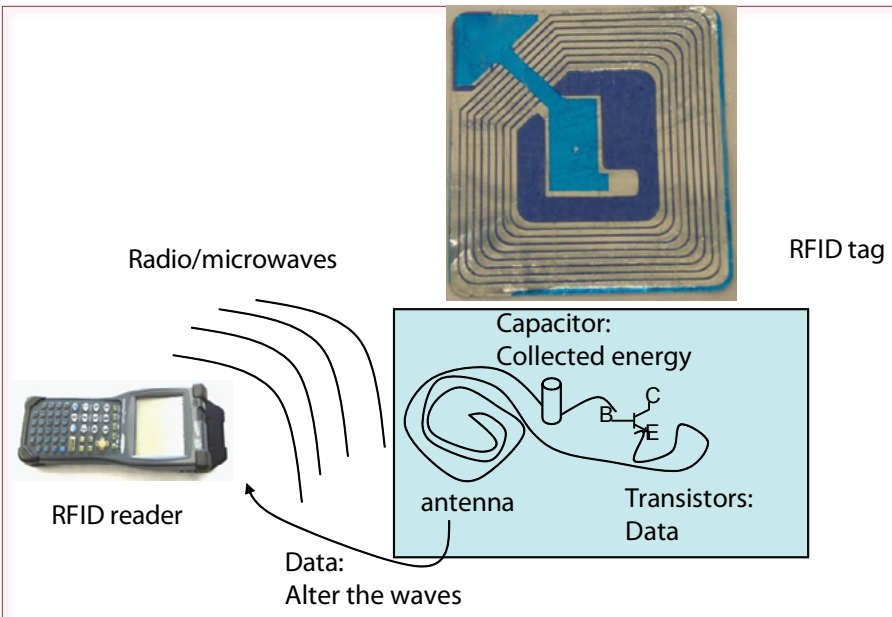


Figure 6.3

RFID capture. The antenna on the tag captures the power from the radio signal to release the data in the transistors and modify the wave signal so that the stored ID can be retrieved.

but hold only 12 bytes of data. The high-frequency chips are typically scanned at less than a foot (with a maximum of 10 feet), but can hold from 8 to 10,000 bytes of data. The ability to read the tags from a distance provides a substantial advantage in supply chain or warehouse environments. Figure 6.3 shows that you no longer have to scan each item from a few inches. You can walk down the aisles with a reader and quickly pick up and distinguish the RFID tags from hundreds of products at a time. The main drawback to RFID at the moment is that the tags are relatively expensive—around $0.20 each. But if you have to count inventory in a store or warehouse several times a year, the RFID tags could save you substantial time and money, plus provide improved accuracy. The scanners also have limitations on the number of items they can recognize at one time. For example, it is doubtful that a single scanner could read the RFID tags from an entire truckload of products at one time.

Wal-Mart and the U.S. Department of Defense are pressing suppliers to put the tags on all items shipped to Wal-Mart. Using their dominant market position, Wal-Mart is asking suppliers to bear the cost of the tags. However, at this point in time, it is probably not economically feasible to include the tags on small, low-price items. Instead, the tags are typically placed on pallets or boxed shipments. RFID tags at this level will probably not be useful in the store itself, but it will help to identify items received and track them through the supply chain delivery system.

Reality Bytes: New Job: Chief Digital Officer of NYC

With the increased sales of smart phones, more people are carrying around devices that be used to obtain and share information. The QR code is a useful method to tag items so people with smart phones can quickly receive information about objects carrying the code simply by taking a picture of the code. New York City hired Rachel Sterne as a chief digital officer to help figure out where to put the codes. The City uses the codes on building permits to enable people to link to the underlying blueprints and construction records. Residents also suggested putting the odes on mass-transit locations, such as bus stops so riders can use them to get up-to-date schedules. Other suggestions included parks and art work—to provide detailed data to interested viewers.

Adapted from Zachary M. Seward, "Where Should New York Place QR Codes?" *The Wall Street Journal*, February 24, 2010.

Ultimately, if tags become cheap enough to place on all items, retail stores might be able to radically alter their format. For instance, scanners could be embedded in shopping carts or doorways. Customers would simply select the items, and get an immediate price and running total. Payment could be virtually automatic as well, so customers could skip the checkout lanes. Cart-based systems could also suggest related products or direct customers to aisles with similar products. Sound farfetched? Albertson's (a grocery chain) began experimenting with these tools in some of its stores in 2003. Most customers were reluctant to use hand scanners and scan everything themselves, but if RFID tags could be used to simplify the process, it might be more useful.

Some privacy advocates have argued against RFID tags on the grounds that if all of your clothes contained these tags (as originally proposed by Benetton), it would be possible to track individual people. However, the limited range of the scanners, coupled with the ability to deactivate or remove the tags, can reduce or eliminate this problem.

Two-dimensional codes (squares) are used in some operations. UPS was one of the first to use them to route and track packages. Today, the QR code standard developed by Denso Wave Incorporated in Japan is available for many purposes. Figure 6.4 shows a sample QR code that was generated from an online Web site. Increasingly, cell phones with cameras can be used to take a picture of a QR code and the encoded data provides a link to a Web site with detailed information. Several Web sites will generate QR codes for free based on the data or Web site you enter. Although the extra data capacity can be useful for packages, the power of smart phones makes the QR codes appealing to marketers. Products, displays, even billboards now carry QR codes to encourage people to obtain background information. Cities, such as New York, are adding the codes to various places, such as bus stops, parks, and public documents. Museums and public art displays are adding them to provide background information about various pieces.

The QR code examples point out some important features of transaction data. Primarily, the format has to be standardized—and it helps

Figure 6.4

QR codes. A two-dimensional bar code that can contain thousands of characters, the QR code was initially created to track auto parts by Denso Wave, Inc. in Japan. Most cell-phone cameras can read the codes so it is often used to link viewers to Web sites containing marketing or background information.

if the standard is free of royalty payments. Also, the codes need to contain enough data to be useful. The old bar codes, and even RFID chips do not contain much data. Larger capacity also improves the capability of the code to handle error correction—where the data can be recovered even if some of the code is destroyed or covered. The presence of low-cost readers—such as cameras on cell phones—ensures the adoption and spread of the code.

POS Advantages

Several advantages arise from using automated data entry. Directly capturing data means fewer errors occur because the machines make fewer mistakes. However, sometimes it is not easy to collect data at the source. POS systems also have built-in error detection methods to make certain the numbers are read correctly. By collecting the data immediately, it is easier to find and correct mistakes. If a clerk using a POS system enters an incorrect product number (or the scanner reads it incorrectly), the error can be caught immediately.

With POS data collection, the computer performs all necessary computations immediately. Hence, the job is easier for clerks and fewer errors will occur. For example, a retail store might give discounts to certain customers. With a POS system, the employees do not have to keep track of the customers or discounts, because the computer can look up the discounts and apply them automatically. Similarly, prices are maintained and changed by the computer. To hold a sale, you simply change the price in the computer (one place) and put up a new sign. Of course, when there are thousands of items and prices, there are still plenty of opportunities for errors.

POS systems also can provide better service to customers. Because the sales data is captured immediately, the managers and clerks always know the inventory levels. If a customer calls to learn whether a product is in stock, the clerk can instantly determine the answer. With most systems, it is possible to tell the computer to hold that item until the customer picks it up. Some companies even connect their store computers together. If you find that one store has run out of a particular item, the clerk can quickly check the other stores in the area and tell one to hold the item for you.

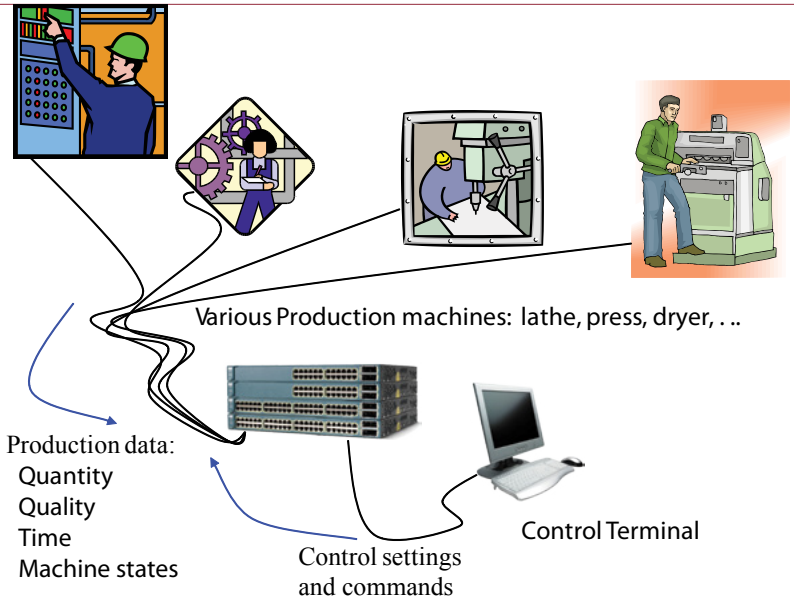


Figure 6.5

Process control is the control of production machines from centralized computers. The computers monitor data from the machines and make continual adjustments. The central control enables designers to specify all production settings from one location.

Process Control

Manufacturing firms often deal with a different type of data. Most factories use machines that can be connected to each other and to computers. The computers can exchange data with the production machines. If you want to alter your product, you would need to change the manufacturing settings on several different machines. If the production line has 10 machines, each with 5 control items that need to be set, it could take several hours to reset the entire production line. And then you have to test and verify every setting. Even a minor change in the product means that someone has to set each of the machines correctly. By connecting the machines to a computer, the computer can store the appropriate settings. When you make a change in the product, the computer sends the correct settings to all the machines. Computers are often used to monitor the progress of the production line. The data is used to identify problem spots and to help the firm meet production goals. Figure 6.5 illustrates the basic concept of individual machines controlled from one location.

Technology also can be used to collect data from manufacturing machines. With this communication, the computer can constantly monitor production levels. Managers can keep track of hourly and daily production, and even track individual products. If a customer wants to check on the progress of a special order, the manager can determine how much of the product has been produced and when it is likely to be completed.

Process control computers can also be used to monitor quality in the manufacturing process. Sensors can automatically measure almost any characteristic. They can check for items such as thickness, weight, strength, color, and size. These

Reality Bytes: Mobile Payments a Tough Sell Without Credit Card Companies
Wireless carriers announced the intention to scale back plans for payments by phone only a couple of months after the joint venture Isis was formed. The goal was to create a new payment method involving cell phones, where carriers would take a percentage of transaction revenue. The main problem was that the system would compete directly against credit-card companies, notably Visa Inc. and MasterCard Inc. Retail merchants and customers are unlikely to use a system that does not include the two biggest players in payments. Drew Sievers, CEO of mFoundry which provides mobile banking technology, noted "Not including the 800 pound gorillas of the industry will make it very hard to succeed." But, the card companies do not need the carriers, so they no longer have a way to take a cut of the revenue. A Nilson Report notes that in 2010, 57.2 percent of debit or credit card purchases were handled through Vias, and another 25 percent by MasterCard.

Adapted from Robin Sidel and Shayndi Raice, "Pay-by-Phone Dialed Back," *The Wall Street Journal*, May 4, 2011.

measurements can then be passed to a computer. If the computer notices a trend or a major problem, it can notify the operators. In some operations, the computer can send messages to the machine causing the problem and reset its controls to correct the problem automatically.

Two basic difficulties exist with process control. First, the large number of machines makes it difficult to establish standards, making it harder to connect the various machines together. Second, production machines can produce an enormous amount of data. Some machines can generate billions of bytes of data per hour. This large amount of data requires efficient communication lines, high-speed computers, and a large storage capacity. Despite these complications, process control can provide enormous advantages. It enables companies to change production processes and alter products faster and more often. It provides better information and control over quality. It enables manufacturers to create products that match the needs of individual customers: mass customization.

Electronic Data Interchange (EDI)

EDI is a form of automated data entry that supports operations by transferring documents between firms electronically. The essence of EDI is the ability to transfer data among computers from different companies. The goal is to connect to suppliers so that production orders can be sent automatically at substantially lower cost than traditional paper-based systems. Two basic methods are used to accomplish the transfer: (1) send the data directly from one computer to the other or (2) send the data to a third party that consolidates the data and sends it to the proper location. Early EDI implementations were based on direct connections as individual firms experimented with the technology. In both methods, two important considerations exist: establishing the physical links and transferring data in a format compatible to all users. The first issue has largely been solved with the Internet. Today, EDI connections can be established through e-mail or Web site links.

For EDI to work, each company must translate its data into a form that can be used by the other companies. If one company like Wal-Mart or GM takes the lead

Reality Bytes: QR Codes from Ethical Bean Coffee Co. Connect to Customers

Ethical Bean Coffee Co. is a small three-store chain of coffee shops in Vancouver, British Columbia. Similar in some ways to Seattle, Vancouver has a surplus of coffee shops on every corner. Seeking a way to stand out, in 2010, Ethical Bean started putting QR codes in its train ads. When customers use their smart phones to scan the QR Code, a menu appears on their screens. Customers can order a cup of coffee while riding the train and pick it up when they arrive at the Ethical Bean shop. CEO Lloyd Bernhardt notes that business has doubled since adding the QR codes and that "We catch people who are on the go and don't have a lot of time." QR codes are easy to generate—several Web sites make it easy to enter a URL or e-mail address and will generate the square bar code free. Scanbuy, Inc., a New York company that develops QR code advertising estimates that 30 million U.S. people have a code reader on their phone. Companies still have to print and distribute the codes in their advertising. Ryan Goff, director of social-media marketing at MGH, Inc. cautions that "QR codes are not the end-all, be-all. They may not exist in two years. But they're a temporary solution to the problem of 'How do you connect people to online things in the real world?'"

Adapted from Emily Glazer, "Target: Customers on the Go," *The Wall Street Journal*, May 16, 2011.

and requires suppliers to send data via EDI, then they are free to define the base transaction objects. Suppliers must translate their objects into the appropriate EDI structure. Yet a supplier might need links to several customers. If each customer used different EDI definitions, the supplier must have a conversion system for each link. Someday it might be possible to create standards for EDI connections, forcing everyone to conform to one type of data definition. Although there is some progress in this area, firms with existing EDI systems will be reluctant to spend the money to convert their data.

Data conversion might sound like an easy task, but it is complicated when the transaction systems were created over long periods of time and were poorly documented. In many cases, the programmer might have to search major portions of the corporate systems to find the appropriate data definitions. Once the appropriate data is found, it can be hard to modify. Existing programs might expect the data to maintain specific formats. Making changes to the data can require rewriting other programs.

The concept of EDI is closely tied to **Supply chain management (SCM)** which revolves around purchasing, but also incorporates just-in-time delivery, searching for competitive pricing, and controlling and monitoring quality.

Proprietary EDI

As displayed in Figure 6.6, most of the early EDI systems were created independently: one large company required suppliers to provide data and accept orders electronically. The goal was to cut the costs of transactions and speed up the ordering process. EDI arrangements also enabled manufacturers to improve quality control and to implement just-in-time inventory systems. Suppliers were "encouraged" to adopt the EDI systems by threatening a loss of sales if the vendors did not comply.

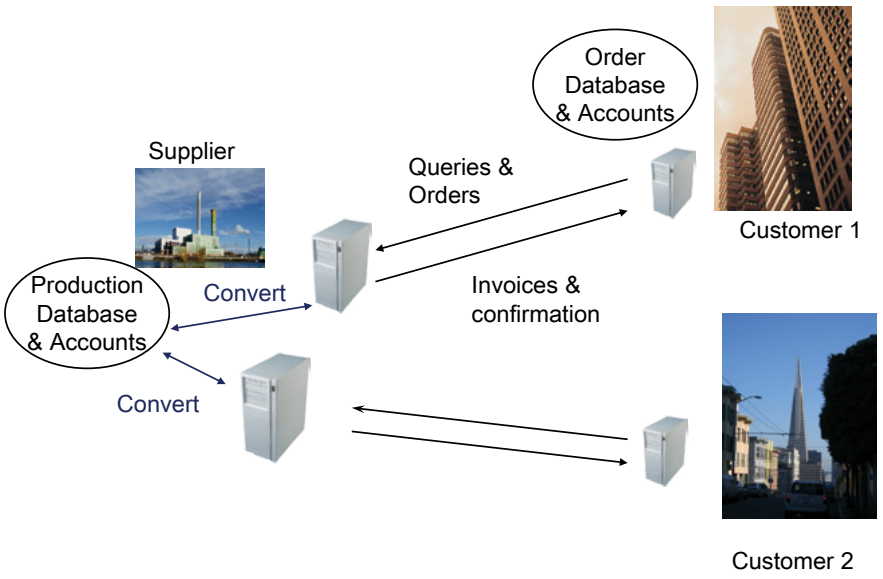


Figure 6.6

EDI can be built from individual pair-wise links over proprietary connections. If the majority of transactions are between two companies, this method will work fine. If companies deal with many different suppliers or large customers, this method can cause problems when each link requires conversion to a different format.

With proprietary systems, the lead firm establishes the standards in terms of the hardware and the types and format of data to be exchanged. From the standpoint of the lead firm, these controls ensure that they are able to connect to each supplier with one standard technique.

To a supplier, proprietary systems created by one company can lead to problems. Imagine what happens when the supplier sells to several firms, and each firm requires the use of a different EDI system. In addition to the hassles of providing data in the proper format for each customer, the supplier's employees would have to learn how to use several different systems. Purchasers face similar problems unless all of their suppliers follow a standard.

EDI Standards and The Internet

Multiple proprietary systems lead to confusion and higher costs. Consequently, several companies have tried to push for standards that make it easier to share data. Two primary standards exist for EDI messages. The UN sponsors the Edifact standard; the United States defined the ANSI (American National Standards Institute) X12 definition. Figure 6.7 shows the overall structure of an EDI message. A significant difference between the standards is in the numbering system used to represent the types of messages, segments, and data elements. Figure 6.8 presents a partial list of the segment types available in the X12 standard. The standards also specify the exact format of the data required in each segment type.

Web sites are used to advertise and display information about products and their availability. Search engines enable companies to find components and potential suppliers quickly. EDI transactions such as orders and request-for-prices can

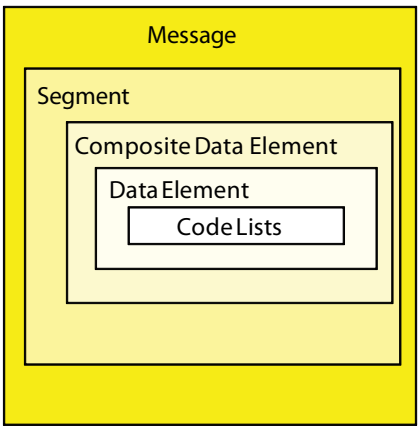


Figure 6.7

EDI standards. UN Edifact and U.S. ANSI X12 standards are similar in format; each message consists of segments and detailed data lists. Each message, segment and data element are defined by numbers from a predefined list of possible transactions. There are substantial differences in the numbering system used for the segments and data.

Figure 6.8

Sample segment codes for ANSI X12. A partial list of the codes used within X12 EDI messages. Only the number is transmitted. Each segment specifies the format of the additional data.

104 - Air Shipment Information
110 - Air Freight Details and Invoice
125 - Multilevel Railcar Load Details
126 - Vehicle Application Advice
127 - Vehicle Buying Order
128 - Dealer Information
129 - Vehicle Carrier Rate Update
130 - Student Educational Record (Transcript)
131 - Student Educational Record (Transcript) Acknowledgment
135 - Student Loan Application
139 - Student Loan Guarantee Result
140 - Product Registration
141 - Product Service Claim Response
142 - Product Service Claim
143 - Product Service Notification
144 - Student Loan Transfer and Status Verification
146 - Request for Student Educational Record (Transcript)
147 - Response to Request for Student Ed. Record (Transcript)
148 - Report of Injury or Illness

```
<?xml version="1.0"?>
<!DOCTYPE OrderList SYSTEM "orderlist.dtd">
<OrderList>
<Order>
<OrderID>1</OrderID>
<OrderDate>3/6/2004</OrderDate>
<ShippingCost>$33.54</ShippingCost>
<Comment>Need immediately.</Comment>
<Items>
<ItemID>30</ItemID>
<Description>Flea Collar-Dog-Medium</Description>
<Quantity>208</Quantity>
<Cost>$4.42</Cost>
<ItemID>27</ItemID>
<Description>Aquarium Filter &amp;amp; Pump</Description>
<Quantity>8</Quantity>
<Cost>$24.65</Cost>
</Items>
</Order>
</OrderList>
```

Figure 6.9

XML for EDI. Data is sent in a standard format that is easy for computers to parse and read. Industry groups have been establishing standard formats and tags for exchanging EDI data within their industries.

be handled over the Internet as e-mail messages. The Internet can also host secure communication channels between two partners. These links can be used for high-volume exchanges of data.

Extensible markup language (XML) was developed in the last couple of years to provide better Internet support for EDI. At its foundations, XML is a tag-based document that contains data. As shown in Figure 6.9, the tags indicate the type of data contained within the document. The document can have a hierarchical structure similar to the EDI standards, such as Order – OrderItem – Product. Various industry groups have been establishing standard document formats (data type definition or DTD) for common documents within their industries. Many software packages can read and write XML documents, so companies can use diverse hardware and software and still communicate easily.

Figure 6.10 shows the sample XML document using a browser. XML is the means to exchange data in a form that all computers can read. At least, that is the promise and hope. XML is still evolving and is still relatively expensive to implement because it often requires customized programming on both ends to handle the data. Software vendors are developing tools that incorporate XML automatically, and suppliers will be able to purchase the software needed to handle the multiple connections to customers.

Extensible Business Reporting Language (XBRL)

The Securities and Exchange Commission (SEC) is responsible for monitoring financial aspects of businesses in the U.S. to protect investors and maintain fair, orderly, and efficient markets. The SEC collects and publishes financial data by

```
<?xml version="1.0" ?>
<!DOCTYPE OrderList (View Source for full doctype...)>
- <OrderList>
  - <Order>
      <OrderID>1</OrderID>
      <OrderDate>3/6/2001</OrderDate>
      <ShippingCost>$33.54</ShippingCost>
      <Comment>Need immediately.</Comment>
    - <Items>
        <ItemID>30</ItemID>
        <Description>Flea Collar-Dog-Medium</Description>
        <Quantity>208</Quantity>
        <Cost>$4.42</Cost>
        <ItemID>27</ItemID>
        <Description>Aquarium Filter & Pump</Description>
        <Quantity>8</Quantity>
        <Cost>$24.65</Cost>
      </Items>
    </Order>
  + <Order>
  + <Order>
</OrderList>
```

Figure 6.10

XML document. XML is designed to transfer data between companies and computers. You can define any type of tag to describe the data.

firms, including annual reports, balance sheets, and income statements. The commission has required firms to submit data electronically for several years. In 2011, the commission moved to require most companies to submit data using a new standard: **extensible business reporting language (XBRL)**. XBRL is largely an XML-based system for tagging specific financial data. Background information is available at www.xbrl.org, and www.sec.gov/xbrl.

The accounting discipline has been around much longer than computers have. Although one goal of accounting is to create standardized views of company performance, accountants and companies have evolved different terms over time. For example, revenue, earnings, and income are all terms that have been used to represent the same concept, and any financial document might use different variations of these terms. These differences make it difficult for computers to read and extract data from financial statements—even if they are in HTML or other digital format. XBRL is designed to encourage accountants to tag all of the data in a statement with a standardized name so that it can be retrieved electronically.

Of course, financial reports are more complex than just lists of numbers. For example, they include footnotes and descriptions. And even the data contains other attributes such as the time period and currency. XBRL has tags and options to handle most of these issues. Figure 6.11 shows a simple example of a tag that is used to display the Revenue for a specified year. This tag can be embedded in a typical XHTML document which can handle the overall layout and formatting. The attributes on the <ix … > tag provide the type of data (name=”ifrs:Revenue”), the units or currency “EUR”, and the actual data to display (6,863,545).

```
<ix:nonFraction
  contextRef="y2012"
  format="ixt:numcommadot"
  name="ifrs:Revenue" unitRef="EUR"
  decimals="0" scale="0"
  id="XWAND00000326">
    6,863,545
</ix:nonFraction>
```

Figure 6.11

XBRL document element. Note that all of the data elements are tagged with standardized identifiers and with attributes that specify the time frame and currency. Source: http://media.ifrs.org/ixbrl_example1_2011-03-25.xhtml

Unlike typical XML, XBRL is not designed for transferring transaction or EDI data. Instead, the tags are defined specifically for reporting summary data. Yet, this data is increasingly used by many people: investors, banks, fraud investigators, and so on.

Elements of a Transaction

What are the major elements and risks of a transaction? Transactions are a critical foundation of modern economic societies. In many ways, transactions define and enable different types of societies and cultures. A transaction consists of an exchange of a product or service for money. Consequently, there is always a risk that something might go wrong in the exchange. Figure 6.12 summarizes the transaction risks that are borne by the vendor, the customer, and the government. The laws and culture determine how these risks are minimized.

Vendor Perspective

At heart, a vendor cares only about one fundamental aspect of transactions: receiving the money. This simple statement has several complicating factors: (1) the payment might never arrive, (2) the payment might be fraudulent, (3) the customer might repudiate the transaction and withhold the money, or (4) the government might invalidate the transaction.

In older times, these risks were minimized through personal reputation of the customer and money based on precious metals. More recently, in our mobile, anonymous society, credit card companies have stepped in to assume much of this vendor risk—for a price. The credit card companies and credit bureaus provide identification and personal reference services. Under the proper conditions, the card companies effectively guarantee payment to the merchant. The conditions primarily consist of (1) keeping good transaction records and (2) identifying the customer through either a magnetic swipe of the card or a signature.

Customer Perspective

In some ways, customers face a more complex set of risks. Their primary concern lies in receiving the identified value for their money. Specifically, they want to be sure that (1) they receive the product or service that they ordered, (2) they are charged only the amount they agreed to pay, (3) the seller does not repudiate the

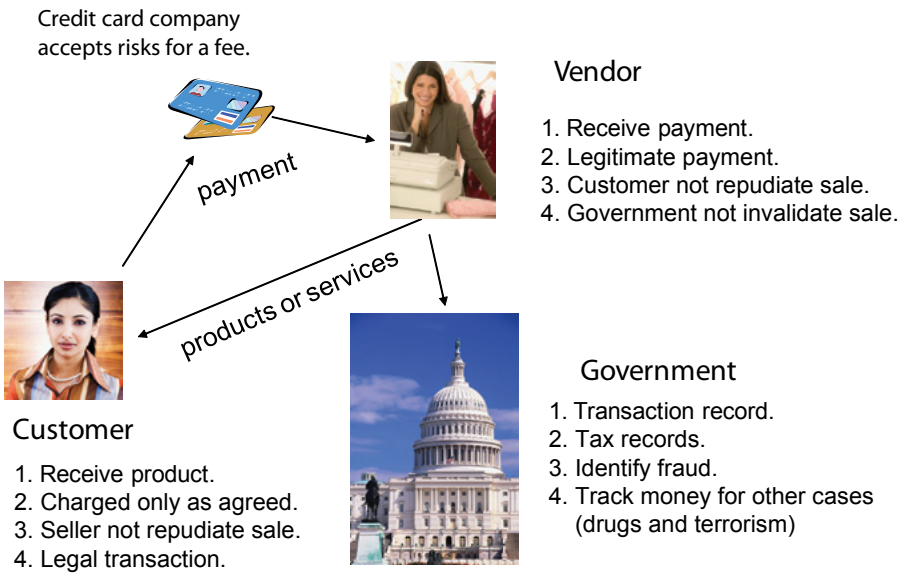


Figure 6.12

Transaction risk factors. Risk elements and causes vary depending on the transaction method. Laws and business procedures are created to minimize these risks, so new laws are needed when transaction methods change.

transaction such as by claiming the product was stolen, and (4) the transaction is legal—for example, not stolen goods that could be confiscated.

In older times, these risks were small when customers shopped at local stores, could physically examine the goods, paid in cash, and received a written receipt. Identification and reputation of the merchant were critical. Even so, fraud was a problem. Again, credit card companies stepped in to reduce much of this risk. Today, credit card companies warranty products, ensure delivery, and validate the merchants.

Transaction Fees

While often invisible to consumers, the fee for using a credit card consists of a percentage of the transaction cost paid by the merchant. Of course, economics shows that the price of the product reflects a portion of this fee, so the consumer and merchant both bear the cost. The cost depends on the size of the merchant, the card company, and the size of the transaction. Typical fees are 1.5 to 5 percent, with minimum costs of about fifty cents per transaction.

What about payments by check instead of credit card? In this case, the vendor bears a relatively high risk that the check is invalid or will be refused for insufficient funds. While there are laws against check fraud, the merchant would experience high costs to recover the money. Consequently, vendors generally contract with specialist firms to validate and process checks. Again, the merchant pays a fee to transfer this risk to another company.

Reality Bytes: You Cannot Buy That

Most people are comfortable buying just about anything using credit and debit cards. But, many people are not aware that the card companies prohibit them from buying certain items. Currently, the list is relatively short, but the point is that the card companies do have this power and no oversight or appeal process exists. What items are banned? The basic list is gambling chips (in casinos), online gambling, online pornography, donations to at least one non-profit organization (WikiLeaks), and medical marijuana. The online gambling case is understandable, because online gambling has been declared illegal by the U.S. government. Medical marijuana falls into the same category. Although some states have made it legal to buy small amounts of marijuana, the federal government still outlaws the purchase of marijuana, so card companies are concerned about their liability. Still, some customers want the option to use their cards for all purchases. The issue of gambling chips is much harder to defend—and the card companies have not even tried to explain. Note that they do allow gamblers to withdraw cash using their cards at casino ATMs—with exorbitant fees and interest charges. The online pornography issue is defended by noting that the number of chargeback claims on those transactions is huge, so the card companies are trying to reduce fraud costs. Still, it should be possible to institute more secure methods for people who want to use their cards. Blocking donations to WikiLeaks is far more disconcerting. Yes, the U.S. government leaned on banks and card companies to block transfers to the site. But, it was not a U.S. organization, and WikiLeaks has never been tried in a court for any legal violations. As John M. Simpson from the non-profit Consumer Watchdog put it "You ought to be able to use a credit card for any legal purchase. It seems to me that credit card companies are imposing their moral values on the world."

Adapted from Quentin Fottrell, "What Your Credit Card Won't Let You Buy," *The Wall Street Journal*, May 31, 2011.

Government Perspective

When discussing transactions, many people forget about the perspective of the government or society. Yet several government organizations have a strong interest in transactions to protect various members of society. The primary interests include (1) an auditable record of transactions and financial statements for the protection of investors, (2) a record of taxable transactions for the collection of sales tax, (3) identification and tracking of fraudulent transactions, and (4) general tracking of money used in transactions to monitor other types of crimes, such as drugs and terrorism.

Most government interests are established by laws and administrative rules that are enforced through manual audits of financial documents. Some data is collected from transaction partners, such as the $10,000 cash reporting rule in the United States. On the other hand, governments are rapidly becoming aware of the jurisdictional problems inherent in electronic commerce. The most prominent issue is the inability of states to force out-of-state firms to collect sales taxes for them.

After a few embarrassingly huge fraud cases in the upper echelons of companies in the early 2000s, Congress got tired of hearing CEOs trying to avoid criminal charges by saying they did not know anything about the problems created by their underlings. So, Congress passed the Sarbanes-Oxley Act that requires execu-

Shipping
Currencies
Languages
Customs and tarifs
Jurisdiction for disputes
Different laws and systmes
Verify seller and purchaser
Payment methods

Figure 6.13

Some international issues with transactione. The basic issues of language, exchange rates, and tariffs are straightforward. Processing shipments through customs can be challenging. Bigger problems arise if something goes wrong because of the different jurisdictions.

tives to take responsibility for all financial reports. The top executives have to certify that the accounting reports accurately represent the status of the firm. The act has scared many executives—not enough to give up their huge salaries and pensions—but they are beginning to search for ways to validate the transaction and financial systems. It is no longer sufficient to just record transaction data—now firms have to institute processes and ensure that people follow them to guarantee that the correct data is being recorded.

International Issues

Why are transactions more difficult in an international environment? In the early stages of e-commerce, several people suggested that the Internet's global reach would make it easy even for small businesses to sell products internationally. However, several factors interfere with international sales. Figure 6.13 summarizes some of the major points involving sales into other nations. Jurisdiction for dispute resolution is a major issue. Nations have many different laws and cultures. Tactics (and content) that might be commonplace in one country could be illegal in another nation. Gambling is a classic example. The United States might ban gambling on the Internet, but how can it enforce that law? On the other hand, if a U.S. citizen has a dispute with an overseas casino, there would be few options to protect the consumer. Similarly, fraud and Web attacks can easily originate from several different nations. Varying laws and lack of coordination make it difficult to identify and prosecute the perpetrators.

Privacy and payment methods present additional challenges. The European Union has privacy rules that are substantially stricter than those of other nations, and it does not want international companies transferring personal data to comput-

Reality Bytes: More Ways to Transfer Money Online

American consumers rarely use checks or cash. Credit and debit cards are still important in transactions, but online payment methods—particularly PayPal—continue to grow in popularity. In May 2011, three of the largest banks in America announced a new service to make electronic payments. The banks involved (Bank of America Corp., Wells Fargo & Co., and J.P. Morgan Chase & Co.) are in a joint ventured named clearXchange. Mike Kennedy from Wells Faro and chairman of the new venture, noted that "Customers want to move payments from paper to electronic methods, so if we can meet our customers' financial needs, they will be better customers with us." The service will rely on the cell phone and is aimed at person-to-person transfers. Money will be transferred directly from checking accounts to another account based on a linked e-mail address or phone number. Initially, the service was released in Arizona and carried no transaction fees; but banks might eventually add fees for the service. Small businesses could also use the technology to avoid paying processing and merchant fees for credit and debit cards. A survey by consulting firm Aite Group LLC noted that in 2010 U.S. households made $865 billion in payments between individuals in 11 billion transactions. Dividing by the number of households yields an average of $7,500 and 96 transactions per household.

Adapted from Robin Sidel and Amir Efrati, "Big Banks Join Battle for Online Payments," *The Wall Street Journal*, May 25, 2011.

ers outside of the Union. Identifying vendors and customers is also problematic when nations utilize different payment mechanisms. Although the major credit cards are accepted in many nations, many people do not use them. For years, transactions between international businesses were largely handled with specialized documents issued among large international banks. With the increasing importance of the Internet, leading to international sales to individuals, these issues become more difficult to solve. Credit card companies and banks largely protect consumers, but international crime makes the task more complex. More importantly, vendors are largely unprotected so many companies are reluctant to sell directly to international customers.

The Role of Accounting

How do you track and compare the financial information of a firm? Accounting systems are important because they extend throughout the company and because they focus on money. They are used to collect data and evaluate performance. Accounting systems also enable managers to combine the many divisions into an integrated picture of the entire company. Accounting systems also provide controls over the data to ensure accuracy and to prevent fraud. The primary purpose of accounting is to collect the financial data of the firm, ensure that it is accurate, and create standard reports. It is hard to capture all of the elements of an accounting system in one illustration, but Figure 6.14 summarizes the essential components of an accounting system. The accounting transaction system can be examined in terms of inputs, outputs, and processes.

If you are not going to be an accountant, why do you need to understand accounting, and why review it in an information systems book? The short answer is that the accounting information system provides the foundation data for the firm.

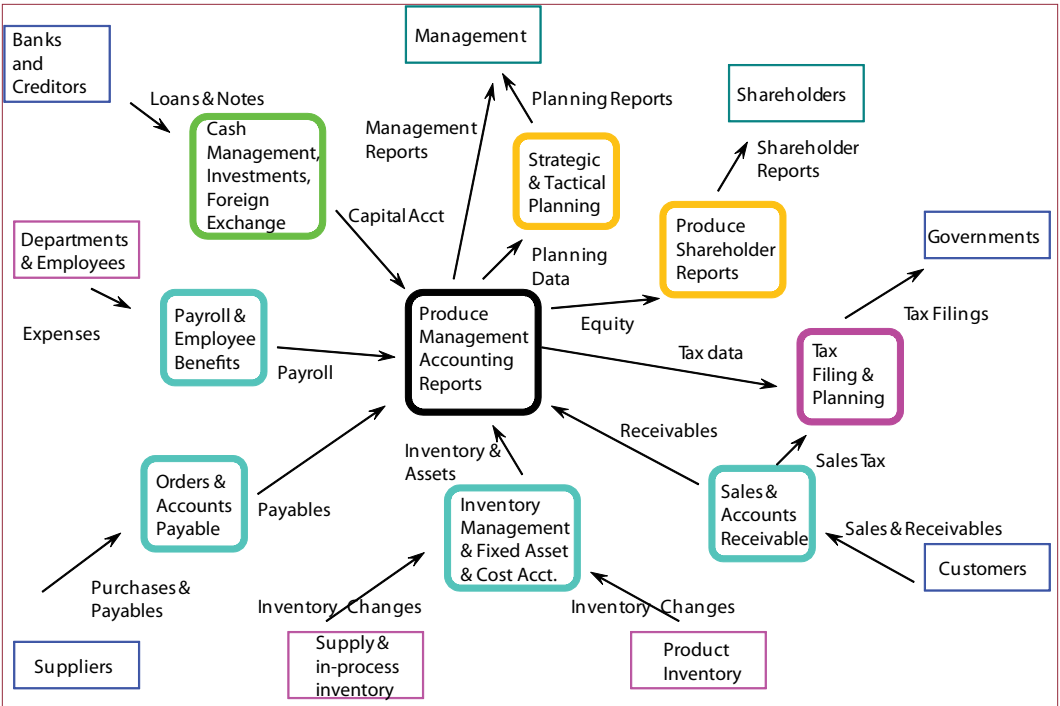


Figure 6.14

Transaction processing is a major function of the accounting system. The accounting system collects data throughout the company and produces consolidated (centralized) reports that are used for planning and management.

The longer answer revolves around the fact that the accounting process is increasingly automated in companies. As a result, all managers have to understand and analyze accounting data. You will have access to basic accounting data and reports directly from the computer. It will be your responsibility to monitor the changes and understand the effects.

Input and Output: Financial Data and Reports

Raw financial data is collected by the accounting department and stored in an **accounting journal**. Modern accounting requires the use of a double-entry system to ensure accurate data. In a double-entry system, at least two entries must occur for every transaction. Generally, one entry records the effect of the money (e.g., cash, accounts payable, accounts receivable), and the other refers to a specific category (e.g., sales, office expenses, commissions). Each entry includes the date, amount of money, account number, the name of the person or firm involved, perhaps a comment, and the name of the person making the entry. The journal's purpose is to record all the transactions.

Journal entries represent raw data. To be useful, this data must be transformed into information. The first step is to categorize the data by *accounts* or categories, which is the purpose of the **general ledger**. The ledger is a collection of accounts that break the data into specific categories. Common categories include *accounts receivable, accounts payable, inventory*, and *cash*. Although some standards

Reality Bytes: Vending Machine Payments

Vending machines can be useful, but they typically have one big problem: They only accept cash. Today, people buy most items with credit and debit cards. If people could pay with cards or even their cell phones, it is possible that sales at vending machines would increase. In 2009, U.S. sales fell 10 percent to about $20 billion—partly because of the recession. Operators would also gain data on specific sales so items would be less likely to run out and they could track the top- and weakest-sellers. The technology exists, so the decision seems straightforward. The problem is that the technology is relatively expensive. And most vending machines are run by small firms who cannot afford the technology. John Mitchell Jr. runs one of larger operations. Treat America Ltd. Of Merriam Kansas, runs about 12,000 vending machines. He notes that "You're catering to a population that might be as small as 30 or 40 people. The unique preferences of that population can drive sales significantly." The company originally stocked machines based on average preferences of the region. In January 2010, Mr. Mitchell converted about 40 percent of his machines to record real-time sales data; which showed that about 40 percent of the 45 slots were "dead spirals" selling fewer than one item per week. Installing a wireless system costs about $300 on a $3,000 machine, and vendor profit margins are typically only one or two percent.

Adapted from Ilan Brat, "Restocking the Snack Machine," *The Wall Street Journal*, August 3, 2010.

exist, each company can define its own **chart of accounts**, which allows owners and managers to examine data on whatever categories are important to their firm. Defining the chart of accounts is one of the important steps in managing a business because it defines the type of information you will examine on a daily basis.

For managers to make comparisons between divisions and other firms, accounting systems produce standardized reports. Most companies produce balance sheets, cash flow statements, and income statements every quarter. These reports are produced following standard accounting rules to enable owners, managers, and investors to compare the financial positions of various companies over time.

Purchases, Sales, Loans, and Investments

One of the primary purposes of accounting is to record the financial transactions with external organizations. In addition to collecting the raw data, the accounting system contains controls that minimize fraud by limiting access to the data. The system also creates summary and detail reports to monitor key information.

Managers often build **exception reports** into the accounting system that are triggered when some event occurs. If sales in some region suddenly drop, if there is a major increase in the cash balance, or if inventories fall below a defined level, a message will be sent to the appropriate manager. The manager typically responds by searching the recent summary reports for a possible cause.

Inventory

Most organizations need to control inventory carefully. Retail stores find it hard to sell items that are not in stock. Manufacturing firms need to receive and process parts as cheaply as possible. Inventory control consists of knowing exactly what

Reality Bytes: Chiquita ERP Problems

In 2006, Chiquita Brands, based in Cincinnati, began a multimillion-dollar upgrade to consolidate its accounting systems and centralize budget planning and forecasting. Operating worldwide with three semi-autonomous business units, the company faced many challenges, including software bugs, staffing shortages, and resistance from the business units. Even after four years, the company was struggling to get all of the components to provide value. CIO Manjit Singh noted that "The general perception is, we got it to work. But it was painful, and the [managers] aren't necessarily looking at this as a successful implementation… Once we start using it for forecasting, I'm hoping the reaction to the project will turn more positive." The system was based on Hyperion and is designed to consolidate data used for forecasting. The goal is to remove e-mailed spreadsheets from the process and get financial planners to use the centralized system so everyone sees the same data and same analyses at the same time. Singh noted that Hyperion (now owned by Oracle) sold the project to the finance group and bypassed IT. IT was called in to support the project after the contracts had been signed.

Adapted from Robert L. Mitchell, "Inside Chiquita's 'Painful' Finance System Overhaul," *Computerworld*, August 9, 2010.

items are available and where they are located. The system also needs to determine when to place new orders. It must then track the orders to make sure each item is delivered to the appropriate location at the right time. With EDI, the inventory control system can monitor current sales and automatically place orders with the supplier.

Manufacturing firms use these systems to implement just-in-time inventory control. The computer system monitors the current production requirements, keeps track of deliveries, and electronically sends orders to the suppliers. The suppliers then deliver the parts just as they are needed on the production line.

Automated inventory control systems also help identify and prevent theft. By recording all movement of items from receipt to sales to shipping, management knows exactly how many items exist. Consider a retail store like a bicycle shop. The computerized inventory notes that there should be three *Cateye computer speedometers* in stock. Yet when a customer asks to buy one, you notice there are only two left. If there is no mistake in your inventory report, you conclude that someone stole one of the items. Although the system did not prevent the speedometer from disappearing, it does show which items are susceptible to theft. It also helps control theft by employees, who will be less likely to steal if they know that the items are carefully monitored.

The Accounting Cycle

An important aspect of accounting systems is that they produce information in specific cycles. Firms are required to produce reports that reflect the financial condition of the firm at the end of every quarter. Accounting systems are based on these requirements. For the most part, managers operate from quarterly reports, with intermediate monthly reports for some items. Because of the volume of data in the detail, most companies keep only current statistics and summary reports on file. Older data is shuffled off the system to make room for the current numbers. As a result, managers may not have easy access to detailed data from prior years.

Technology Toolbox: Selecting an ERP System

Problem: How do you select and evaluate ERP systems?

Tools: : Several ERP systems and even more ERP consulting firms exist to give you choices and help you evaluate your options. Choosing a system is relatively difficult because of the costs. The cost of the hardware and software is high, but you face larger costs in converting from your existing system and redesigning your business processes. Once you have implemented a particular ERP system, it is difficult to switch to another vendor. So, you have to be careful to select a system that is going to work for your particular organization. Today, most large companies already have ERP systems, so the growth market lies with small and midsize businesses. Most of the ERP vendors are actively targeting this SMB market. Businesses within this category have to pay attention to the anticipated growth and scalability options of the software systems. For example, even small businesses can gain the advantages of ERP systems by leasing them from companies that host the software on Internet servers—you pay only a monthly fee.

In terms of technical business features, most of the large ERP systems are somewhat similar—offering the standard accounting, HRM, SCM, and CRM integration. However, you will find differences in ease of use, internationalization, and customization options. For a smaller business, one of the more important areas to look at is the quality of the predefined industry-specific application. Most ERP vendors provide shells that are customized for each industry, so it takes less time and money to set up the system for your company.

Planning Stage	Goals and Outputs
Initiation	Estimate costs, establish objectives, select team
Initial planning	Initial vendor list and basic features (hardware platform, fees, internationalization, vendor size and stability, and so on).
Requirements gathering	Identify business requirements. Detailed list of specifications, unit goals, and critical features. Evaluation criteria.
Demos and selection	Product demonstrations, ratings, and site visits.
Implementation	Customize applications, convert data, restructure company operations, define new processes, and train employees.

Selecting an ERP system is a time-consuming task, and you have to carefully evaluate the needs of the company. You will create lists of primary objectives and generate detailed specifications. You will endure hundreds of hours of vendor presentations and comparisons of databases, reports, and customization capabilities.

Then you have to implement the solution. Many companies work with a partner consulting firm that specializes in one ERP system. This detailed knowledge simplifies the conversion process because the consultant firm has experienced experts. But even midsize firms take six months to a year; larger operations can require a year or two. Most companies choose to implement ERP systems in stages—perhaps accounting first, followed by SCM and CRM. Even these packages can be split and implemented in smaller pieces.

Quick Quiz:

1. Assume you work for a midsize construction firm that does about 30 percent of its work internationally. Find at least three ERP vendors and outline the features they provide.
2. Assume you work for a large retail clothing firm with stores in most U.S. states. Identify the specific accounting and financial features you would want in an ERP system.

Process: Controls, Checks, and Balances

Double-Entry Systems

An important objective of accounting systems is to maintain the integrity of the financial data. The goal is to prevent mistakes and discourage fraud. Double-entry accounting provides a method to locate mistakes in data entry. If an amount is entered incorrectly, the account totals will not balance.

Because many transactions involve outside organizations, mistakes can be caught by sharing data. Every month firms receive a statement from the bank. The totals can be compared to changes in the firm's cash account. Similarly, companies typically send receipts when they receive payments from each other. Auditors periodically send verification requests to suppliers and customers to make sure the data was recorded correctly. EDI strengthens this approach, because transaction data is transmitted in computer form among the companies.

Separation of Duties

Another type of control is the separation of duties. A manager in the purchasing department might be responsible for choosing a supplier of parts. Only the accounting department can authorize the transfer of money to the supplier. The objective is to minimize fraud by requiring a potential thief to deal with multiple employees.

Many banks take this concept a step further. They require employees (especially tellers) to take their vacations every year. Several instances of fraud have been revealed when the employee was no longer at the job to keep the fraudulent mechanism running.

Audit Trails

An **audit trail** is important to accounting systems. It enables investigators to track backward through the data to the source. A cash flow statement might indicate that the company has spent twice as much money this month as last. To find out why, trace backward and find all of the raw entries that make up the number. Together with dates and amounts, the raw journal entries can contain the identity of the person responsible for the entry. By keeping this identification data, it is possible to list every article that affects an item on a report.

Human Resources and Transaction Processing

What are the transaction elements in the human resources management system? Every company has employees. Companies collect hundreds of pieces of data for each employee—some for management purposes, others because they are required by law. For years, the human resources (HR) department focused on filling out and storing forms. The enormous amount of paperwork alone begs for computerization just to cut down on storage space needed. Computerized databases also enable managers to find specific data on employees. Early HR software emphasized these two benefits. Modern HR software is expanding beyond simple forms to improving data collection and providing better analyses. To illustrate the problems presented by large-scale transaction-processing systems, consider the three areas of input, output, and processing.

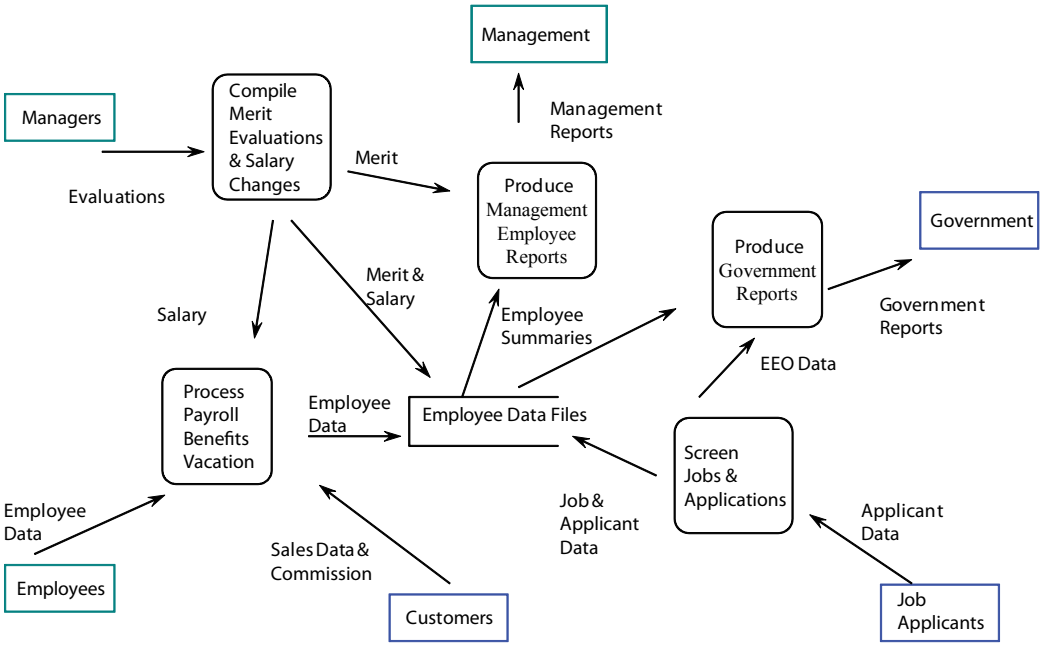


Figure 6.15

Most employees know that human resources management (HRM) deals with payroll and benefits. But HRM also collects data and produces reports for a myriad of government reports, oversees employee evaluations and job applications. The department also handles training and education opportunities.

Input: Data Collection

Figure 6.15 illustrates the basic components of a human resources management (HRM) transaction-processing system. Note that the system is even more complex because the data comes from all areas of the company. To understand how the HRM systems became so complicated, begin with the obvious data that needs to be collected: numbers related to the payroll. For hourly workers, the system needs to collect and monitor hours worked. For many sales tasks, the system must compute sales by employee to determine commissions. Professional service firms often ask employees to track their time in terms of billable hours for work that is charged back to clients. In all three situations, as the number of employees increases, it becomes increasingly difficult to collect all of these statistics and verify their accuracy. It also becomes harder to find specific pieces of data.

Think about paychecks you have received. In addition to the payment amount, there could be 10 to 20 other numbers on the pay stub. Companies monitor and report several types of payroll taxes, including federal, state, local, Social Security, and health. Also, firms monitor employee benefits, such as health care and retirement. Most firms also handle employee deductions for employee purchases, savings plans, stock purchases, parking, meal plans, and other options. In some situations, companies must garnishee wages and forward them to a third party.

Human resource departments also track days taken for vacations, personal time, and illness. In larger companies, HRM provides training courses and offers testing of critical skills. Employee attendance and performance data is stored and incorporated into evaluations.

With the increasing use of merit pay, the system must also track employee evaluations. Some performance measures are tied to productivity or output within the employee's department, so HR must relate employee work schedules to production and quality measures. Most companies use a centralized HRM department to advertise job openings and to screen the initial applicants, verify credentials, and keep basic employment and hiring data.

Output: Reports

The human resources department also produces several reports related to payroll. Along with printing checks, HRM must provide expense reports and forecasts to the accounting system. Periodic reports are created for job vacancies and analyses of employee performance and morale.

HRM departments also spend a great deal of time creating reports for various government agencies. All companies must file various economic reports dealing with employment. Tax-withholding data must be filed regularly with federal, state, and local agencies. HRM departments create equal employment opportunity reports detailing characteristics of their workforce, job applicants, and hiring decisions. Then there are various reports required by the Occupational Safety and Health Administration (OSHA) regarding injuries and exposure to various hazards. If employees need to be certified, companies file aggregate reports with the various regulatory agencies. All of these reports have deadlines.

In addition to the standard reports, the human resources department is responsible for maintaining compliance with all relevant employment laws. Hence, HRM staff must continually monitor the employment data and evaluate it for exceptions and problems.

Process: Automation

The human resources department is a busy place. Keep in mind that the data and reports apply to every branch of the company. Even standard items such as paychecks become complicated when the company is split into several divisions scattered across the country. Also, remember that accuracy is crucial. Employees can become upset if their paychecks are wrong. Errors with government reports can lead to fines and lawsuits. Equally important, companies with good HRM departments are able to offer additional benefits to employees. With a good information system, they can offer cafeteria-style benefits where each employee selects a personal combination of benefits.

Small businesses have long complained about the burdens imposed by government reports and data collection. To alleviate some of the hassles and expense, several companies specialize in automating the data collection and report writing. Consider payroll: Because of the constantly changing laws, many companies rely on an outside agency to collect data and print the paychecks. One of the largest providers is Automated Data Processing (ADP). Even if a company chooses to maintain its own payroll records, it typically purchases the software from a third party instead of trying to keep up with the annual changes using internal programmers.

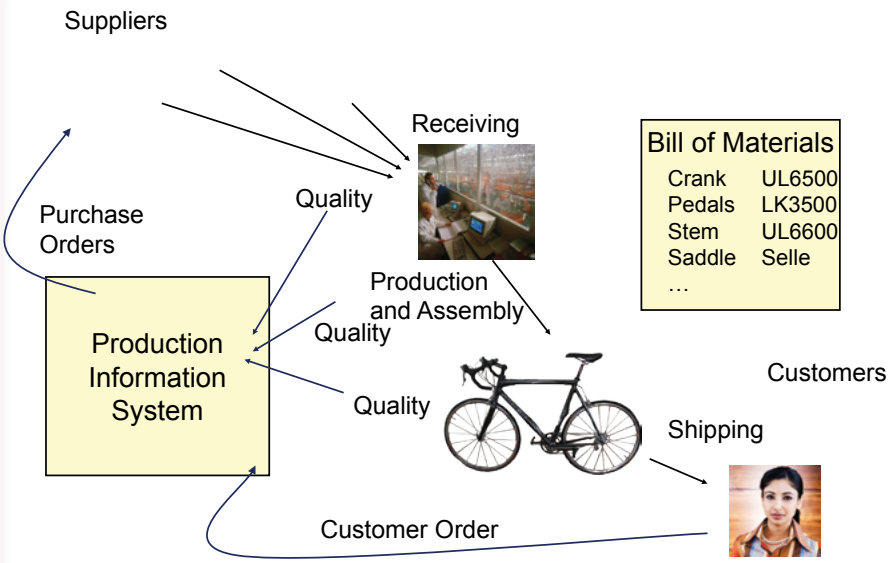


Figure 6.16

Production management. Production of goods and services generates considerable information. Purchase orders are placed with suppliers, internal documents like the bill of materials record production, shipping invoices record interactions with customers. Quality control measures are recorded at several steps in the process.

Several companies sell software that automates HRM data handling and produces government-required reports. From economics to equal employment to OSHA reports, the basic HRM reports are being computerized. You still need to collect the data in the proper format and convert it to the purchased software. In addition to saving time in producing reports, the packages often contain the essential government rules and can analyze the data to spot potential problems.

Some newer technologies are being used to simplify data gathering. In particular, companies are searching for ways to make it easier for workers to deal with the HRM department. A system created by PRC, Inc., uses touch-tone phones and a voice-response system to enable workers to make changes directly to their base information, like changing their address or tax withholding. Another approach is to install PC-based kiosks and use the Internet, so that employees can look up information, sign up for training classes, or modify their personal data whenever they wish. Other companies are using similar software and the corporate network to allow workers to perform basic HR tasks from their desks or from home using the Internet.

Production Management

Can a company become more efficient and productive? Sometimes this question is easy to answer—if you have been losing money. But perhaps you are manager of an organization that has been successful and profitable. Many companies have been successful for years and continue to operate the same way they always have. This practice might not be bad in every case, but the concept of **continuous quality improvement** dictates that you should always look

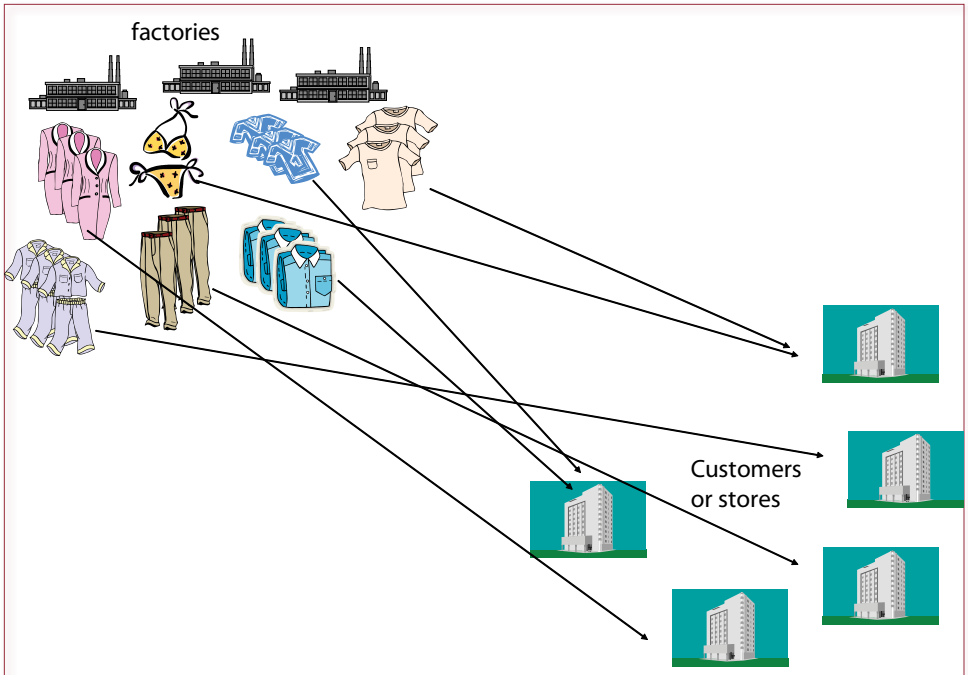


Figure 6.17

Production challenges. Multiple factories produce many items that are shipped to hundreds of customers. How do you schedule efficient production? How do you ensure the right products go to the correct locations?

for improvements—no matter how successful you have been. New production and information technologies are introduced continuously. Any one of these technologies might give you the ability to leapfrog your competition, or it might give your competitors the ability to squeeze you out of the market.

As shown in Figure 6.16, information technology has several important uses in production management. It is important to track orders, shipments, and all steps in the production process. The **bill of materials** is an important concept in manufacturing. It records the components that were used to manufacture a finished product. Data on it is used to trigger deductions in inventory of parts and signal the addition of the final product to finished inventory. These actions impact the accounting ledgers, so recording the proper amounts and time is important. Similarly, quality control measures are taken at several steps in the process—particularly with the receipt of supplies and the shipment of finished products. Detailed quality measures during the production process are used to identify processes, machines, and employees that need improvement.

Production Issues

Manufacturing in large scale presents several problems and issues to management. As shown in Figure 6.17, consider the case of a clothing manufacturer with several factories. Each factory can produce multiple items and the company works with many factories. The items are collected and shipped to hundreds or thousands of customers and stores. How do you schedule efficient production? How do you

Reality Bytes: Controlling Enterprises with BPM

In the early 2000s, New York Attorney General Eliot Spitzer filed lawsuits against several insurance companies for fraud and excessive fees. Politely stated, the entire industry appeared to suffer from poor management with limited knowledge of how fees were collected and disclosed. Integro Insurance Brokers was founded in New York in 2005 with the idea of applying business process management principles and software to the industry. Christophe Marcel, enterprise software architect stated that "there were a lot of questions about transparency and disclosure of where fees came from. There has been an industrywide initiative for quality improvement processes… To do that effectively, you need BPM." Using tools form BEA Systems Inc, the company built client-services applications to provide up-to-date data on transactions, and enable executives the ability to monitor all of the processes. Harcourt Assessment Inc., a San Antonio-based developer of scholastic tests, is using BMP software from Savvion Inc. to manage the process of developing test questions, using the system to automate online processes for collecting and analyzing customer feedback.

Adapted from Heather Havenstein, "BPM Is Helping Firms Control Critical Business Processes," *Computerworld*, October 30, 2006.

ensure that the right products are shipped to the correct stores? These questions seem obvious, but they are critical. In the 1980s, the huge designer jean company Gitano self-destructed because it was unable to answer these two questions.

Obviously, information systems are a key component to the answers. But you need to make sure the processes are in place to collect the correct data in a timely manner. This data has to be available throughout the company so managers can monitor for problems and make the correct decisions. For instance, with only partial data, it might appear that a factory is idle, while complete data might show that it is scheduled to ramp up production as soon as supplies or new machines arrive. Collecting data in a manufacturing environment can be a difficult process. Most workers are busy trying to build products and are not interested in taking time to enter data into a computer. You need to define the processes and jobs to ensure that accurate data is also being recorded. You also need to automate as much of the data collection as possible. Some machines can transfer data directly into the information system, but often you need to assign the task to someone. This step is particularly important when things go wrong. You also might have to add bar-codes or RFID tags to products so they can be counted and recorded automatically.

Once you have accurate data, you can usually purchase tools or hire experts to analyze the production processes and find improvements. The field of production operations management has many tools and models to organize and optimize production and scheduling.

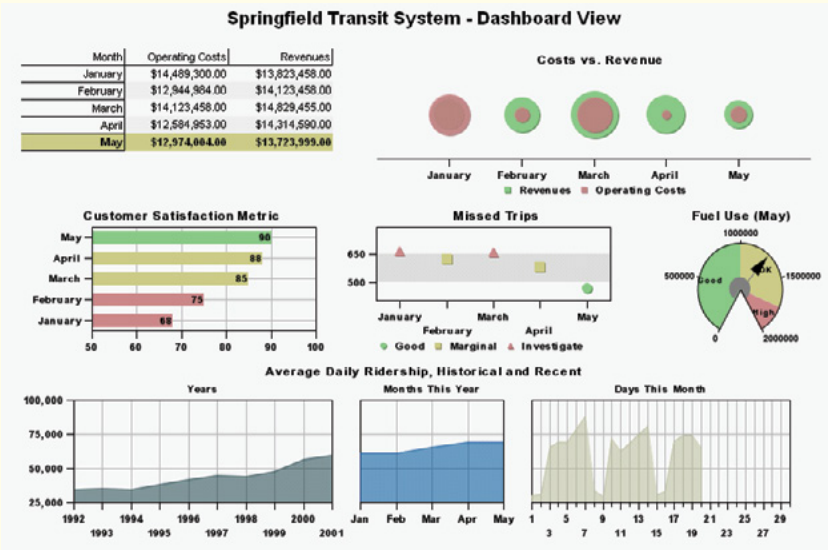
Distribution and Inventory Control

A key mantra in today's business is that you do not want to hold inventory. **Just-in-time (JIT)** production was designed to eliminate parts inventories held by manufacturers. Instead, suppliers are asked to deliver parts exactly when they are needed. In one sense, the process shifts the inventory onto the supplier, because the supplier is penalized if it is late with shipments. But, ultimately, it reduces the

Technology Toolbox: Designing an Executive Information System/Dashboard

Problem: How do you begin to understand the data collected by an ERP system?

Tools: Executive information systems or digital dashboards are designed to display summary data in real time. The systems usually begin by presenting a graphical overview using some primary measures of the organization. Executives and managers can quickly compare progress on key variables. They can then drill down and see more detailed statistics and even original transaction data such as orders.



http://www.visualmining.com/ncs/projects/Examples/PerformanceDashboard/TransitMetrics.jsp

An EIS can be a powerful tool to follow the progress of the company. Most ERP systems have some type of software that makes it relatively easy to extract data and create an EIS. However, one of the most difficult tasks is to identify the key items that need to be displayed on the main form. Across industries, companies vary enormously in the outcomes managers need to follow. Even within an industry, firms and managers rarely agree on what items are the most important. Consequently, each company needs to develop an EIS customized for its executives.

One approach to identifying the desired elements in an EIS is to follow the balanced scorecard method proposed by Robert S. Kaplan and David P. Norton. They recommend a complete analysis beginning from the top to identify the main strategic goals and derive measures that fit into primary categories. For instance, you would typically need measures on financial, customer, internal data, and learning and change. The top managers cooperate to identify the main indicators of each variable.

Quick Quiz:

1. Assume you have been hired to help a regional law firm. What key elements might go on the main EIS screen?
2. Assume you have been hired to help an airplane manufacturer; design the main EIS screen.
3. To help design an EIS for a retail video store chain, briefly describe the screens and steps needed to identify stores that are performing below par and find possible causes of the problems.

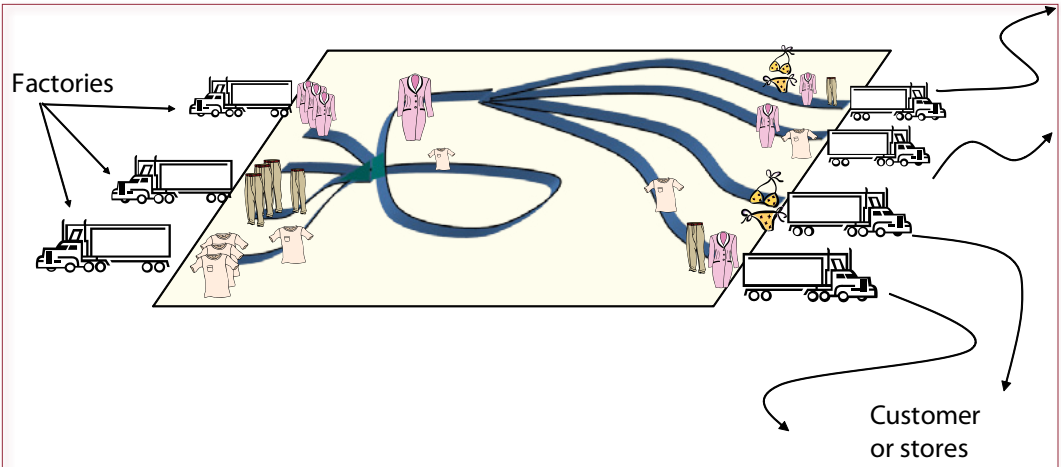


Figure 6.18

Distribution center. Factories deliver products in bulk to the DC. High-speed conveyors read bar codes on the incoming boxes to split the products into smaller shipments and route them to trucks headed for individual stores.

number of products held in inventory because everyone along the supply chain is interested in minimizing the value of the stalled inventory. Instead, everyone forecasts production needs and delivers products by keeping them moving through the supply chain.

As shown in Figure 6.18, the **distribution center (DC)** is an important part of a modern supply system. Incoming bulk shipments are unloaded from the trucks and placed on high-speed conveyor systems. Bar code readers in the center of the DC read each box. Outgoing trucks are matched to a specific customer and store. The computer reads the customer order list and routes the specified number of boxes of each item to every truck. When the trucks are loaded, they deliver the items to the designated customer and store. Additional savings are created by routing the same truck to the ship or rail yard freight docks to pick up an incoming bulk shipment. These trucks then deliver the bulk shipments on the left side of the DC in the diagram. Scheduling systems keep the trucks moving to maximize their capacity and to reduce deadhead or empty loads.

Distribution centers might be run by manufacturers, customers, or third-party transportation specialists. Wal-Mart is a leader in using the centers to reduce costs and deliver exactly the needed products to every store. Ultimately, you also need to match your shipment data against the customer receipts to ensure that your system is accurate and to compensate for shipping losses.

Integration in Business

How do businesses combine data from operations? The easiest way to understand the power of today's computer systems is to look at how integration has changed over time. Almost any organization has issues with integration. Consider a basic manufacturing company that has several production plants and sells into multiple markets. The managers need to track production data, costs, and quality from each plant. Figure 6.19 shows that they also track sales by region

Production

Plant	Quantity	Quality	Costs	Prior Month
Boise	260,721	9.6	$41,222,697	219,961
Decatur	171,371	8.75	$31,094,809	188,862
Yaounde	314,856	9.4	$29,119,967	406,859
	746,948	**9.25**	**$101,437,473**	**815,682**
		Wtd. Avg.	135.80	

Sales

Region	Quantity	Avg.Price	S
US East	225,091	$289.17	
US West	204,725	$273.20	
Canada	65,763	$192.00	
South Ame	67,495	$133.50	
Other	47,313	$169.00	
	610,387	**$211.37**	**$**

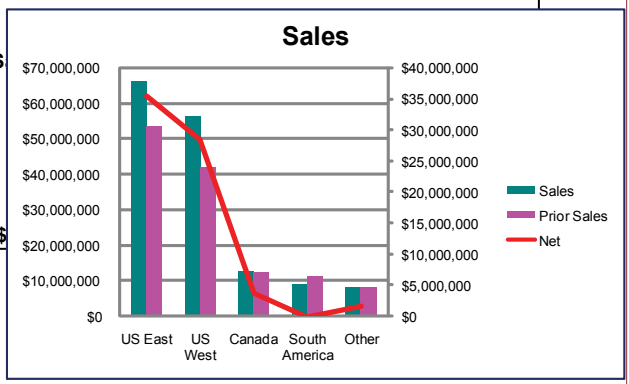


Figure 6.19

Integration with ERP. An ERP system can integrate almost all aspects of the company into one huge database. Either directly or through an executive information system, management can retrieve any report or piece of data by selecting options.

and use average costing to estimate net profits. ERP systems support considerably more complex analysis and integration across suppliers and customers as well as financial institutions. But the basic ideas are the same.

Assume that you are a manager responsible for producing the integrated report. You need to collect the basic data, perform some simple computations, create the report, and write a report for management discussing the results. The process of creating this report has changed considerably over time. Figure 6.20 shows the various methods by decade. It is important to understand all of the methods because it helps you appreciate the amount of work and steps processed by a modern ERP system. Also, companies are at different levels of development, so you could end up working for a company that uses any of these technologies.

In the 1960s and 1970s, computer systems were built for individual departments and areas within the company. In many companies, these systems became islands. They were focused on one task and did not share data with each other. For instance, the accounting department collected the basic transaction data and produced the necessary accounting reports. Anyone in the company who wanted to use this data relied on paper printouts of the standard reports. When spreadsheets arrived in the 1980s, the basic accounting numbers were often rekeyed into spreadsheets in other departments. Besides wasting employee time in retyping numbers that were already stored on a computer, this practice caused more errors from mistyping the data. Furthermore, consider that when the accounting department changes the numbers, some users of the data might not get the updated versions, and people would attempt to make decisions on the basis of outdated data.

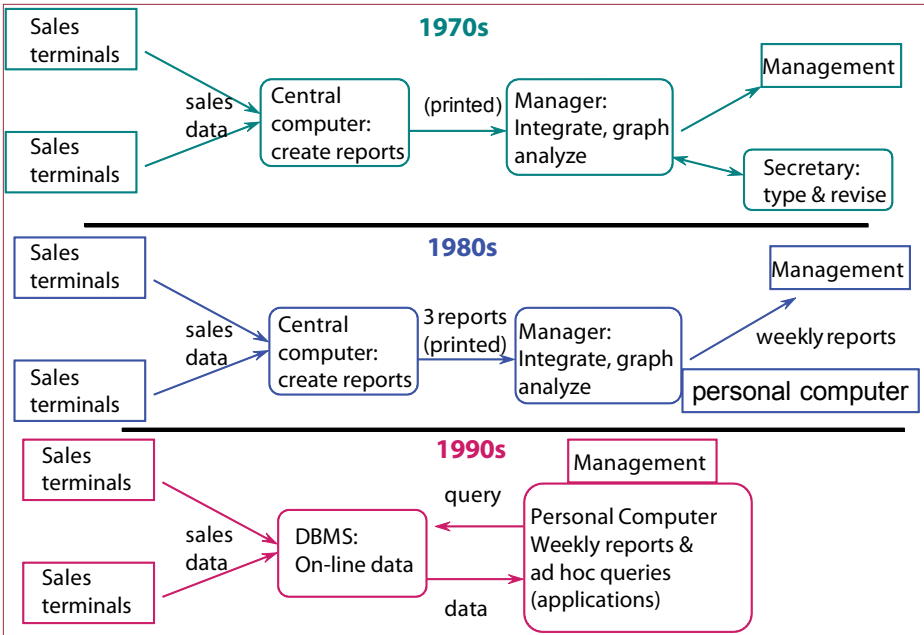


Figure 6.20

Middle management over time. The methods used to create integrated reports have changed over the past three decades. With simple transaction systems, managers computed the totals, drew graphs, and had secretaries type the report. With the adoption of personal computers, middle managers (or their secretaries) reentered the data into spreadsheets and used a word processor to print the final report. With an integrated system, top managers can use a personal computer to query the database, draw the graphs, and produce the final report.

Notice that in the 1980s, the clerical support was replaced with PCs. As a manager, you are expected to write your own documents and create your own charts.

In the 1990s, organizations began the steps toward integration. The basic transaction is stored in a DBMS, and networks provide access to the database. More important, this integration makes it relatively easy to create automated tools that extract the desired data, display results in charts, and enable managers to quickly find the answers to basic questions. To some extent, this type of system means that the company no longer needs you: the middle manager. You might be interested to know that this trend was predicted in 1958 (Levitt and Whisler, *Harvard Business Review*). It just took 20 years longer than they anticipated for technology to be developed.

As shown in Figure 6.21, in the first decade of 2000, even more powerful integration tools were adopted. The goal of these tools is to integrate all of the data in the company, including ties to suppliers and customers. Again, the entire system runs on a DBMS; the difference lies in its reach and its capabilities. Tracking customers and working closely with suppliers are increasingly critical functions in business. Just collecting the data and billing customers or paying suppliers is not sufficient. You need to be able to analyze and compare the data. Who are your best customers? Which ones cost you the most? Which suppliers provide the best qual-

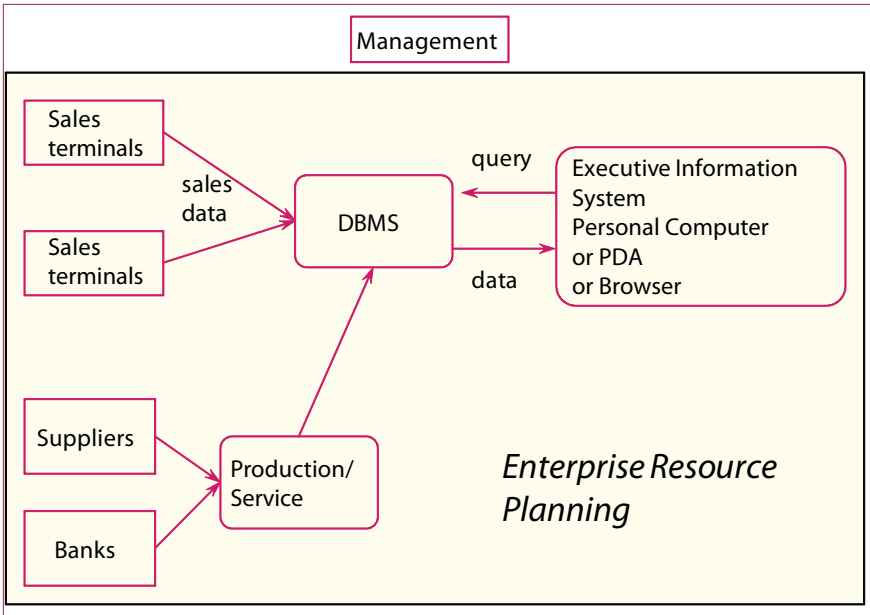


Figure 6.21

Integration with ERP. An ERP system can integrate almost all aspects of the company into one huge database. Either directly or through an executive information system, management can retrieve any report or piece of data by selecting options.

ity and are the most reliable? Answers to these questions can mean the difference between success and failure.

Enterprise Resource Planning

How do you combine data across functional areas, including production, purchasing, marketing, and accounting? **Enterprise resource planning (ERP)** is the current state of the art in integrated information in business systems. The systems incorporate data from financial accounting, logistics, and human resource management. The field is dominated by large, expensive software packages from companies such as SAP, Oracle, Lawson, and Microsoft Dynamics. The systems use databases, processes, and rules to provide up-to-the-minute data on the major financial issues in a firm. One of the key points of ERP systems is that they run on top of a DBMS; hence, all of the data is centralized and accessible via DBMS queries and reports.

As shown in Figure 6.22, ERP systems handle all of the financial accounting systems. They also emphasize purchasing, human resource management, and investment management. The systems are tailored for specific businesses and can focus on areas such as manufacturing, research and development, and retail sales.

One of the primary strengths of the ERP systems is that they were designed to handle data for large companies operating in an international environment. In the late 1990s, many companies chose to install commercial ERP systems, instead of trying to modify their existing systems to handle the year 2000 problem.

Computer use in most companies began with transaction-processing systems. Because transaction systems are structured and there is considerable experience at

Accounting
: All transaction data and all financial reports in any currency

Finance
: Portfolio management and financial projections

Human Resources Management
: Employee tracking from application to release

Production Management
: Product design and manufacturing life cycle

Supply Chain Management
: Purchasing, quality control, and tracking

Customer Relationship Management
: Contacts, orders, and shipments

Figure 6.22

Primary ERP functions. Each area has dozens of additional detailed functions. The real key is that all of the components are integrated. For example, any data entered into the HRM system is immediately reflected in the financial reports.

this level, it is a logical place to begin. However, it is also tempting to treat each transaction separately: (1) payroll services can be purchased from a specialized data processing company, so the data will be handled separately from the other corporate data; (2) a sales order-processing system might be constructed independently of the inventory control system; (3) process control systems to handle manufacturing tend to be isolated because the data (e.g., robotic control signals) are different from the data used in the rest of the company; (4) similarly, the corporate accounting system is often developed as a stand-alone product. Journal entries are created by copying data in reports produced by other systems. Although each of these transaction systems offers management advantages to their respective departments, it is difficult for managers to use data from other departments. Also, independent systems make it difficult for executives to share data and evaluate interrelationships between the departments.

The amount of data integration needed in a company often depends on the management structure of the firm. Some firms are highly decentralized, so that each business unit makes its own decisions and functions independently of the others. Typically in these situations, only accounting data (profit/loss) are integrated and reported to upper management.

On the other hand, some organizations are much more integrated. In your economics courses you were shown the difference between vertically and horizontally integrated firms. Consider a vertically integrated firm such as an oil company that functions at different levels of production (including oil exploration, drilling, transportation, storage, and retail sales). Although an oil exploration team may not need access to daily fuel sales in New York State, they do need to forecast future demand for oil. Likewise, the retail sales division does not need to know the daily costs associated with drilling for oil, yet they might need to track deliveries and communicate with the corporate office.

Consider a horizontally integrated firm such as Wal-Mart with retail stores in many different cities. It achieves lower costs by combining the buying power of all its stores. By coordinating sales, warehouses, and distribution, Wal-Mart can negotiate better prices with manufacturers. Moreover, Wal-Mart reduces operating costs by standardizing management practices (and information systems)

Reality Bytes: Paying for the Train

Long Island Rail Road trains do not accept credit cards. And the tiny train station in Amagansett in the Hamptons does not have ticket vending machines. Conductors will accept cash, but most young riders do not carry much cash. So they get a bill, which they might or might not pay. One rider, Renee Osgood, noted that "You don't always plan ahead to make sure that you have cash on you. I never really carry around cash, anyway." In response, LIRR president Helena Williams noted that the railroad is increasing the number of signs, asking riders to carry cash.

Adapted from Andrew Grossman, "Cashless Hop Rides on the LIRR," *The Wall Street Journal*, July 27, 2010.

across all the stores. By integrating information from all stores, it is easier for Wal-Mart to forecast customer demands. Also, by networking the store information systems, managers who experience higher sales of certain products can request shipments from stores that are not selling the item as rapidly.

Manufacturing firms can gain additional benefits from integrating data. Benefits like just-in-time inventory, total quality management, and mass customization can exist only with the tight integration of data. The National Bicycle Industrial Company of Japan illustrates how integrated data is used to provide customized products to mass markets.

International Environment

Several ERP features are important to firms operating in an international environment. First, all menus and reports should be available in several languages, so clerks and managers can use the language they prefer. Second, the system should handle currency conversion automatically, so managers can view reports in any currency. Similarly, conversions should be capable of being fixed at a point in time, so that when items are transferred, they can be valued at the exchange rate in effect at that time, even if the rate changes later.

A more complex feature for the international environment is the ability to produce reports following the rules of individual nations. For example, a company with subsidiaries in many nations would need to produce reports that follow the rules (e.g., depreciation) for each specific nation, and then produce consolidated reports following the rules of the home nation.

A third complicating factor arises from taxes. In addition to the rates, the rules and procedures vary by nation. The rules are particularly important for payroll and benefit applications. A good enterprise application automatically incorporates the rules for each nation and state.

Financial Accounting

The accounting system is a core feature of an ERP. Eventually, all transactions must be recorded in the general ledger accounts. The accounts fulfill the standards required by each nation. They are used to create the standard accounting reports. The systems provide flexibility by enabling managers to create their own subaccounts and subledgers, which are used to create reports on additional topics. An important feature of the accounting system is that standard accounting reports can

Reality Bytes: Marin County ERP

County governments perform many tasks that are similar to common businesses. ERP software exists for government agencies, but it typically must be heavily customized. In 2006, Marin County in California signed contracts with SAP and Deloitte Consulting to build a new ERP system to replace the old legacy system. By mid-2010, Marin executives were unhappy with the system and filed lawsuit against Deloitte Consulting, claiming that only 50 percent of the functionality is available and working. David Hill, director of the county's IT services department argued that "In order to make it happen with SAP, we would need to re-architect it, redesign it, and that would be quite expensive." The budget analysis estimated fixing and supporting the SAP system would cost at least $34.7 million over the next ten years; which starting over with a new tool would cost $26.2 million.

Adapted from Chris Kanaracus, "Marin County to Rip and Replace Ailing SAP System," *Computerworld*, August 24, 2010.

be generated at any time for any section of the company. The ERP system automatically uses the most up-to-date data.

In addition to standard financial accounting, the systems manage assets and provide common treasury functions such as cash management. The systems also provide basic audit trails and other accounting controls. To make them easier to use, most ERP systems provide enterprise (or executive) information system (EIS) capabilities. Managers can examine data at virtually any level of detail. From summary values, they can drill down to more detail.

Logistics

Logistics consists of the operations required to purchase materials, deliver them to the warehouses and factories, and sell and distribute products. It incorporates traditional MRP analysis, quality control, accounts payable, and accounts receivable.

In today's manufacturing companies, logistics is an important component of just-in-time inventory and demand-driven production. Using an integrated system, the marketing department gets up-to-the-minute data on customer demands. Marketers can cooperate with designers and engineers to develop new products. The specifications can be transferred to the production machines and raw material orders can be generated for vendors. Purchasing and payments can be tracked and generated over EDI networks—including the Internet. As orders are generated and inventory levels change, the accounting data is automatically updated—providing instant analysis of profitability.

For service-oriented companies, logistics involves service management tasks. The ERP systems can track customers, identify repeat customers, monitor service contracts, help salespeople with call management, and handle automatic billing and accounts receivable issues.

Human Resource Management

Payroll is a complicated function, particularly in a multinational environment involving different rules and currencies. Even in a single state, the issues of benefits, state and federal rules, and legal issues arising from child support make handling payroll a complex task.

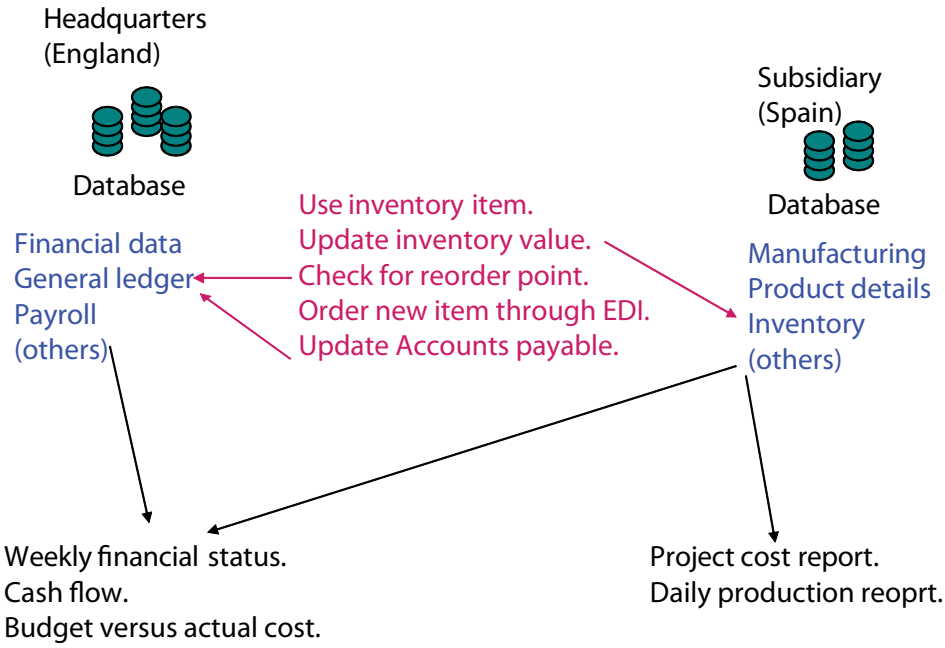


Figure 6.23

ERP integration. Although data can be distributed, it is still integrated across the organization. Changes in one item (inventory) cause changes in all related databases. Reports are generated from current data.

Today's HRM departments handle such additional tasks as recruitment, training, travel, and organizational planning. Each step must be documented and requires a variety of federal and state reports. In addition to these basic tasks, most of the major ERP systems enable HRM departments to offer Web access to basic data. For example, employees can use the Web to check on their taxes, change their withholding status, and sign up for benefit plans and training sessions.

Integration

Integration is probably the most important feature of the ERP systems. All the data is stored in a central database; hence, data is entered only one time (but into a double-entry accounting system). All reports are generated from the base data. Custom queries and reports can be generated through the DBMS.

Consider a simple example. A manufacturing plant takes an item from inventory. The system instantly adjusts the inventory quantity on hand. It also updates the financial value of the inventory holdings on the general ledger and any subledgers that utilize that figure. New orders can be triggered automatically with the orders and payments sent through common EDI mechanisms. All of the changes are made automatically. When managers request reports, the new data is automatically incorporated and displayed using current currency conversions.

The key point to remember is that all of the transactions and accounts are integrated. Managers can request reports by using any combination of data at any time—and each report will use the most up-to-date information.

Reality Bytes: Applicant Tracking

About 61 percent of North American companies use applicant tracking software to scan and sort job applications. According to a survey by HR research firm Bersin and Associates, even small and mid-sized businesses have begun adopting them. The firm notes about 55 different vendors sell applicant tracking system (ATS) software. The largest vendors include Taleo, silkroad, Oracle, iCIMS, Lumesse, and Kenexa. Job applicants use a Web site to upload a resume which is then scanned for key words and routed to the appropriate location if it finds enough matches. An interesting aspect to the software is that many of them do not fully support PDF files. So job applicants should typically submit a resume in Word format.

Adapted from Kelly Eggers, "Resume Debate: Word v. PDF," *The Wall Street Journal*, May 25, 2011.

Most of the major ERP systems also utilize distributed hardware and software. Hence, the database can be split into many pieces stored in different locations. As changes occur in one location, they are automatically distributed across the network to the other locations. The company can add a subsidiary with its own processing support. Yet, all of the new data is readily accessible to managers throughout the company.

Figure 6.23 provides a simple example of data integration. When a factory uses an inventory item, the system reduces the current inventory count. It also changes the inventory valuation in the general ledger. The item usage might trigger a purchase through the EDI system, which must also be recorded—along with the accounts payable change. Since the databases are shared across the organization, all changes are automatically included when new reports are generated.

Remember that all of the modules are integrated. So manufacturing schedules developed in the production module automatically provide data to the payroll system and personnel systems. Then the financial data (e.g., wages) is linked back to the general ledger, which provides updated data for all financial reports.

One important catch with an ERP system is that it requires changes to the way the company operates. In many cases, these changes can be good—for example, it forces everyone to follow the standard accounting procedures. In other cases, the ERP is too inflexible and interferes with the way the company operates. Managers have to carefully evaluate the trad-eoffs of integration and flexibility.

Supply Chain Management

How do you make production more efficient? Supply chain management (SCM) concentrates on the production side of ERP. It begins with logistics (purchasing and receiving components), through manufacturing configuration, and into distribution of the products. As shown in Figure 6.24, these factors involve a significant portion of the company, requiring integration of a huge amount of diverse data.

The key to understanding the value of SCM is to go back in time again to see how manufacturing evolved. From the 1920s through the 1970s, companies in many industries recognized the importance of economies of scale or mass production. The automobile industry presents the classic example. Producing thousands

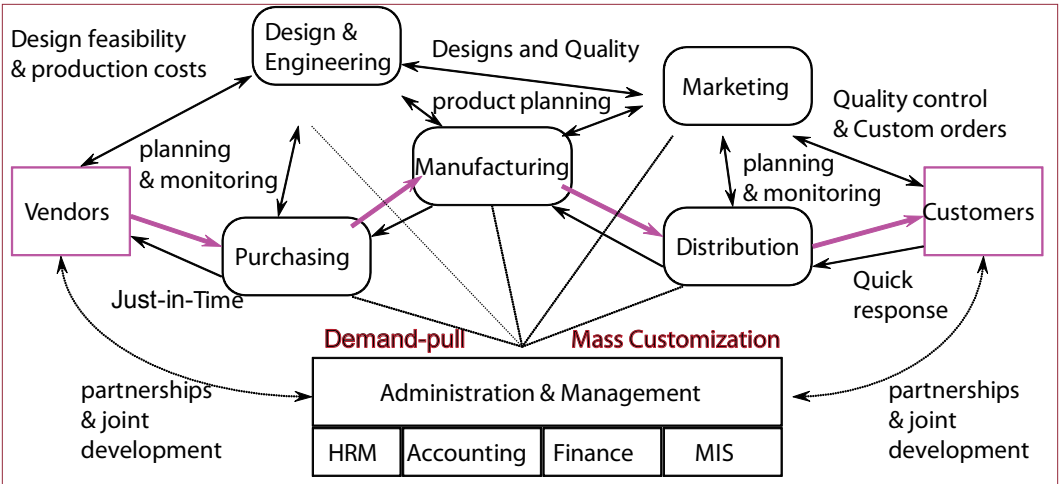


Figure 6.24

Total data integration begins with the vendors, tracks data through all operations of the firm, and incorporates information from customers. Each area in the firm has easy access to data from any other location. This integrated data is used to make better decisions by enabling managers to focus on the big picture instead of on local solutions.

of identical cars enables the company to spread the huge fixed costs across a large base—leading to lower average costs. The huge scale enabled the car companies to negotiate better prices with suppliers and dealers, reducing costs even further. So, in the name of lower costs, the companies produced thousands to millions of identical items. They relied on the marketing departments for two critical purposes: (1) forecast consumer preferences in advance, and (2) convince consumers they need the products that were built. So, the car salesperson says, "Sure, we could order a car for you, but it will cost more and take months. You would really be happier with this car and you can drive it home today."

Of course, mass production has the potential for mass disaster. If you predict incorrectly, or cannot convince customers to buy the existing product, you end up dumping the products at sale prices. Remember that you have to clear the way for next year's models. More critically, mass production means that it is impossible to please all of the consumers—leaving a niche open for your competitors. A niche in the small-car market enabled Toyota to become one of the largest producers in the world.

SCM Changes the Focus

So how does SCM help? It can change the entire system. Mass production begins at the supply side and builds products as cheaply as possible to eventually sell to consumers. With a truly integrated supply chain, it is possible to start with the customers. The marketing department identifies exactly what each customer wants. The customized orders are entered into the system, and the engineering department evaluates the order, makes design changes as needed, and schedules production. Manufacturing knows each desired production date and organizes products to minimize production costs. Component orders are placed with suppliers elec-

tronically. On the day of production, as components arrive, they are scanned into the system and routed to the appropriate location. At the same time, payments are scheduled with the banks. As the parts arrive at each machine, the central process controller configures each machine correctly as the product moves through the assembly line. At the end of the production line, the product is labeled and shipped to the appropriate customer. The customer can be notified electronically and billed automatically.

Imagine how much easier it is to be in marketing now. Instead of convincing customers to buy what you have produced, you first find out exactly what they want, and that is what you sell them. It is not quite that simple, but at heart, that is the principle. **Mass customization**.is the process of manufacturing products designed for specific consumers but using mass-production techniques to keep costs low. It can be done only if you have an integrated system. In many cases, it is not possible to produce exactly what the customer wants (after all, most customers want the world for free). And sometimes you have to produce for groups of similar customers instead of a single consumer, but the principle is the same—use the integrated technology to provide as much customization as possible. For example, it might never be possible to produce a truly customized automobile economically, but customers might be satisfied with more choice of options.

JIT production is an example of how integrating information can change a production process. Japanese manufacturers created this method with low-tech *kanban* signals that conveyed information along the production line to the suppliers. Today, ERP systems can provide immediate information from all stages of production. This information can be made available to suppliers so they can schedule deliveries. The overall goal is to reduce production costs and eliminate bottlenecks by reducing the need for huge inventories.

SCM Challenges

SCM and integration are powerful tools. You might expect all firms to be using them heavily. But SCM has two serious obstacles: (1) cost and (2) establishing connections and agreements with outside firms. The issue of cost can be overcome—although the tools are expensive, if they can save enough money, the cost is acceptable. But that explains why smaller firms with fewer purchases might not be able to afford the technology. The second issue of building connections across multiple firms is far more difficult.

A key issue in SCM is connecting to suppliers electronically. It can also require connections to distributors and transporters. Each of these hundreds of companies could have different hardware and software. Plus, all companies involved have to worry about security issues. Sharing data is a more difficult problem than simply blocking all access. B2B e-commerce is an interesting solution proposed to solve some of these problems. In the late 1990s and early 2000s, several B2B auction sites were set up to coordinate purchasing and tracking of products within an industry. For example, Covisint was established by several automobile manufacturers to handle transactions for automobile components. Few of these electronic auction sites survived the dot-com crash. However, some are still supported and used in major industries, such as automobiles and steel.

To a typical consumer, purchasing seems like an easy process: you find a product and buy it. As shown in Figure 6.25, the reality is considerably more complex. Consider the purchase of a new item. First the buyer has to identify the purpose and individual features desired. Then the buyer identifies potential suppliers and

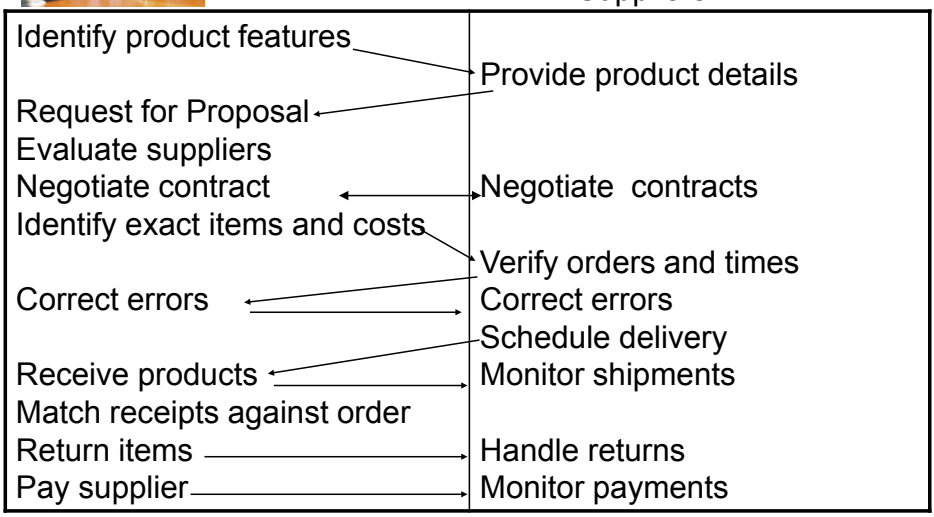


Figure 6.25

SCM Purchasing. Purchasing is considerably more complicated than it appears. It often requires several interaction steps with suppliers—even for existing relationships. Monitoring prices, quality, and timeliness is critical to both sides.

sends a **request for proposal (RFP)**. The suppliers select products that match the desired features and make proposals and bids for the sale. The buyer evaluates each request, selects a supplier, and negotiates a contract. From this point, the process is similar, even for repeat orders. The buyer generates a list of specific products, prices, and quantities, along with a desired delivery date. This purchase order is sent to the supplier, who verifies the orders and checks to make sure products are in stock and available for delivery. Any problems with prices or delivery times require notifying the buyer and negotiating changes. Eventually, the products are shipped to the buyer along with an invoice detailing the items delivered. Of course, the buyer has to verify the quantity and quality of the items received. Any discrepancies are recorded and the seller is notified. Some items are returned. Ultimately, the seller sends a bill to the buyer detailing the amounts owed. On the accounting side, the appropriate accounts payable entries have to be made. Finally, the supplier has to be paid, and needs to monitor receipt of payments and match them against the bills.

One goal of an ERP system is to automate as many of these tasks as possible. Figure 6.26 shows a version of an ERP screen for a buyer or product planner. Other screens enable suppliers to connect and electronically pick up purchase orders or check on the status of deliveries and payments. All data is entered into a shared database. From the buyer's perspective, notice the scorecard that quickly indicates the status of several key variables. Additional tools on the page enable the buyer to check on the current inventory status of individual products. For example, he

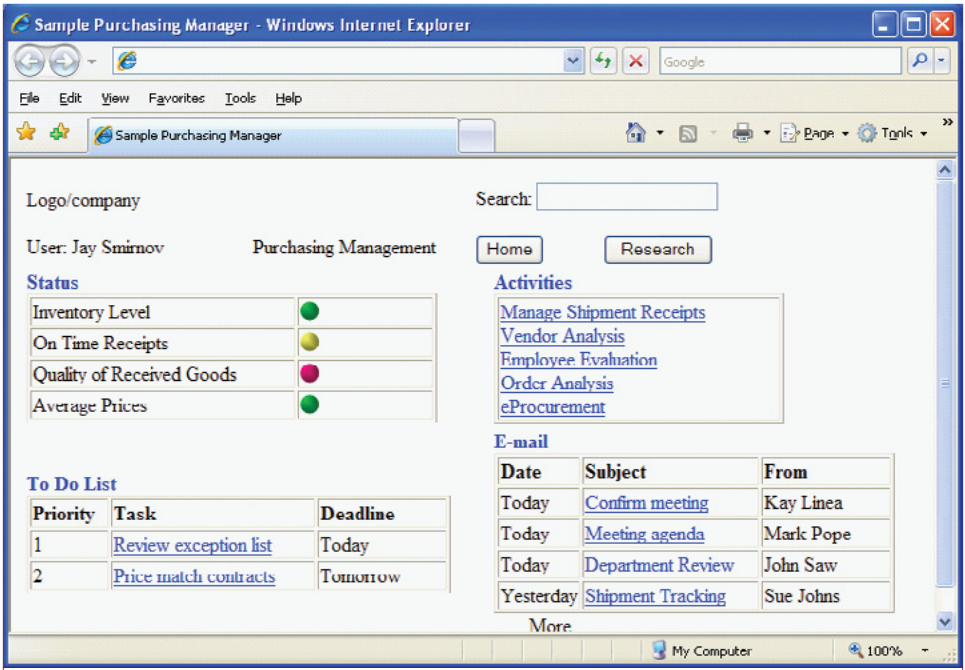


Figure 6.26

Purchasing manager perspective. Notice the scorecard to indicate important performance variables. This portal page includes links to tools that help manage day-to-day tasks.

can quickly see if the company has too many items in stock for a particular product. Additional tools provide the ability to examine payments, shipments, problems or exceptions, and perform analyses on vendors and products.

Integration across Systems

The buyer-seller relationship points out a major challenge that remains to be solved: how do you exchange data electronically between buyers and sellers? Today, both the buyer and seller probably have ERP systems, but they might be from different vendors. Even if they are from the same vendor, they might not format data the same way. So, the buyer will ask the seller for a person to log in and check on the supplier data. Similarly, the seller will ask the buyer to log in and use its system.

The major work in the 2000s by the ERP vendors has related to connecting systems and sharing data electronically. XML is one tool that was established to help companies exchange data. As shown in Figure 6.27, ideally, each company would implement an interface that would accept and read XML documents sent from its partners. The machines could quickly parse the documents and transfer them into the required internal format. Internal functions could then schedule deliveries, check on shipments, or transfer payments. All of the data within an XML document is in a specified format and tagged so that a computer program can quickly read the file and identify the data and its purpose. Several companies, including IBM and Microsoft, are developing technologies to use XML to make it easier to share data across companies.

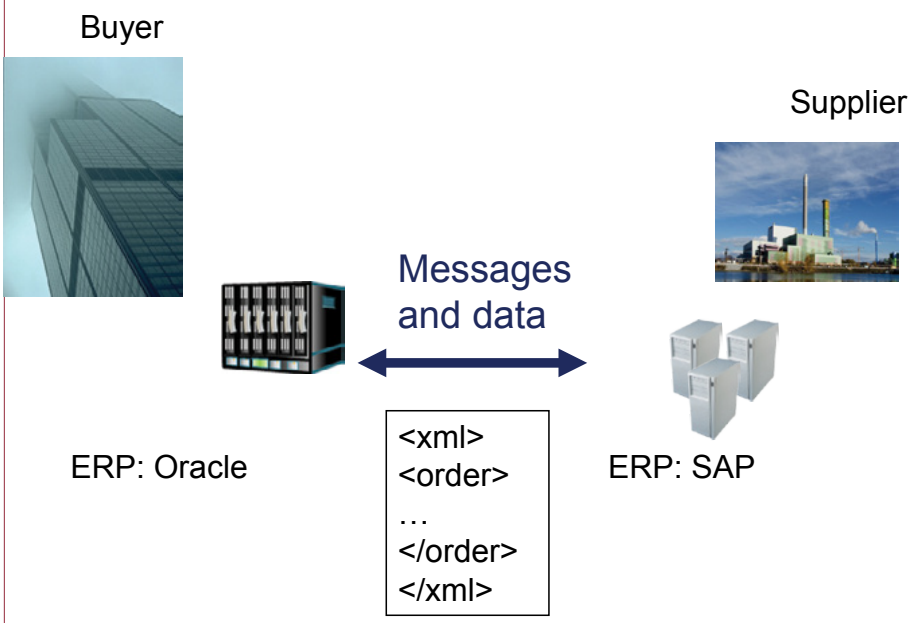


Figure 6.27

The role of XML. XML is used the transfer messages to diverse systems. Each system contains tools to read and write XML documents and convert the data into the appropriate internal database tables.

Customer Relationship Management

How do you keep track of all customer interactions? Who are your best customers? Although customers are important to all businesses, the Internet and wireless applications add new dimensions to managing customer relationships. One problem is the expanding number of customer contact points, from sales representatives, to call centers, to Web sites, and wireless connections. Customers expect merchants and suppliers to remember actions and decisions that were made earlier—regardless of the method of contact. Consequently, companies need integrated systems that instantly provide all details of customer contacts. The new technologies also provide innovative methods to keep in touch with customers and identify their specific needs to sell additional products and services. Several software tools have been developed to improve **customer relationship management (CRM)**. Most ERP systems have added (or purchased) CRM systems to provide an integrated contact and sales management system.

Multiple Contact Points

One of the greatest challenges facing a company today is the multiple sources of contact points with customers. Most of the original systems designed to handle these interactions are separate. Salespeople often keep their own records, Internet support systems may not be totally connected to the sales fulfillment centers, and faxes are rarely integrated into the online customer files. But customers assume that when they talk to one person, that person has records of all the prior interactions.

Reality Bytes: Customer Relationship Management at Dow

Most people do not think about the mundane tasks that computers handle—such as sorting data. Computers have been doing it for so long, that it is taken for granted. And sorting is relatively standard—for small amounts of data. But sorting large amounts of data is definitely not trivial. In 2010, computer scientists at UC San Diego set a world record for sorting when they were able to sort one terabyte of data in 60 seconds. A full minute seems like a long time to wait for a sort, but a terabyte is a ton of data to move around. The task required 52 computers with dual quad-core processors and 24 gigabytes of RAM, plus 16 500 GB disk drives. The team also set a record for the fastest data sorting rate. The system sorted one trillion data records in 172 minutes (almost three hours). Alex Rasmussen, the lead graduate student on the team noted that "Sorting puts a lot of stress on the entire input/output subsystem, from the hard drives and the networking hardware to the operating system and application software." Many business transactions and reports require sorted data, including search results and product recommendations.

Adapted from Daniel Kane, "Data World Record Falls as Computer Scientists Break Terabyte Sort Barrier," UC San Diego News Center, July 27, 2010.

At first glance, it appears that it would be straightforward to build an integrated application to hold all customer interaction data. Of course, it would be a lot of data and would take time to build the application. But the real challenge lies in getting everyone to enter all of the data. Consider the situation of a salesperson who has invested time and collected substantial data on product preferences and customer work environments. That information gives an advantage to the salesperson. Why would the salesperson be willing to share it?

Customers with multiple divisions and many different product tracks also add complications to CRM. The system has to be able to track transactions, questions, and issues by a variety of factors (date, product, company, person, and so on). The system also needs a sophisticated search routine so users can find exactly the pieces of data required.

Feedback, Individual Needs, and Cross Selling

The main purpose of CRM systems is to provide individual attention to each customer to improve sales. By tracking prior purchases, you understand the status of your customers. By providing new channels of communication, you improve the ability of customers to provide feedback to comment on products and services and to make suggestions for improvements. By identifying patterns in purchases, you can develop new ideas for cross selling. If a group of customers tends to purchase several products, you can search the CRM database to find customers with only part of the solution and have your salespeople demonstrate the advantages of the entire suite—using the other customers as examples and references.

The flip side to CRM is that collecting and coordinating substantial data about the customer can lead to privacy problems. As long as the data is secured and used internally, few problems arise. But firms still need to be sensitive to customer wishes about unsolicited contacts. In fact, customer privacy requests need to be part of the CRM system. The issues are more complex when the selling firm has multiple divisions, and each one wants to push new products to existing custom-

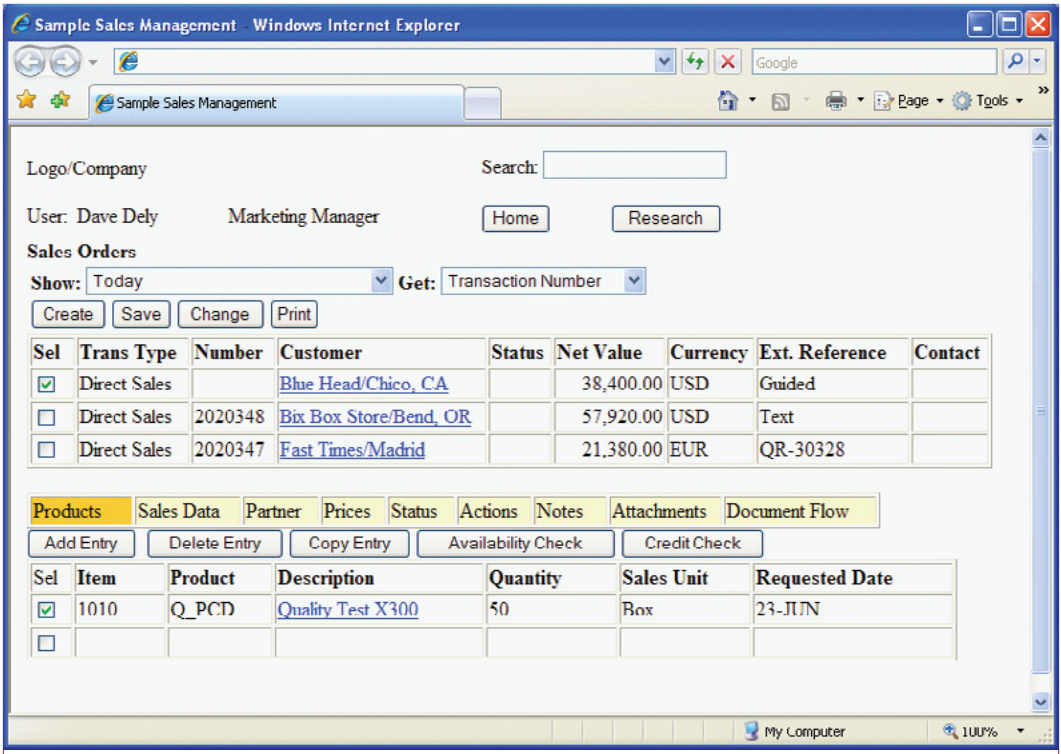


Figure 6.28

Sales and CRM from a sales manager's perspective. Keeping all the customer interaction data in one location makes it straightforward for the salesperson to understand all of the company's associations with each customer.

ers. The marketing staff needs to use the CRM system to coordinate and monitor all contacts.

Wireless applications provide even more options for CRM. Your salespeople can stay in constant contact with the corporate database. They can retrieve current shipping status or detailed customer information during a sales call. They can forward questions or comments, which can be analyzed and answered immediately.

CRM Packages

ERP systems often have a CRM component that provides a unified view of customer data. For example, as Figure 6.28 shows, sales managers can quickly check on the status of customer purchases, returns, or any other transaction involving customers. When salespeople call on customers, they need to be able to quickly retrieve all of the recent transactions with that customer. Perhaps the customer had problems with a recent shipment, or perhaps they just placed a new order. The salesperson can review those activities before calling on each customer. Then the salesperson can investigate any problems or check on current status and provide immediate answers to customer questions. One of the biggest challenges with a CRM system is collecting the necessary data. An ERP system will have all of the basic transaction data—from the perspective of the main company. But will salespeople enter all of their personal data into the system?

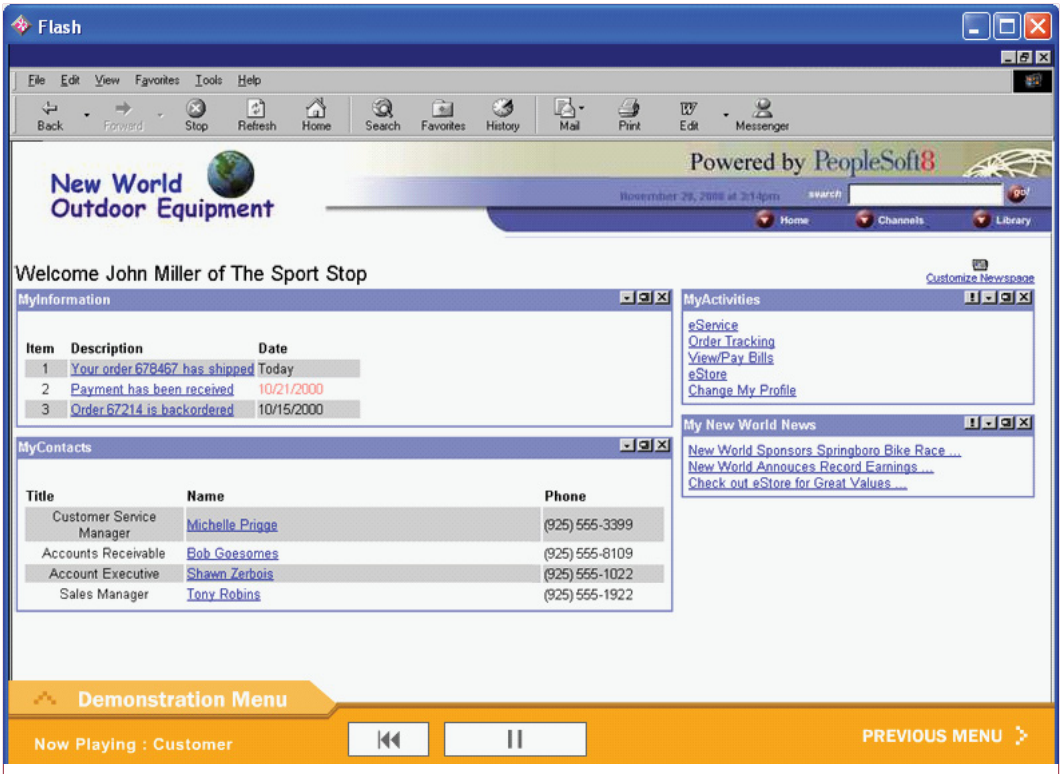


Figure 6.29

PeopleSoft CRM from a customer's perspective. The portal into the ERP system enables customers to check the status of various items, order new products, and contact the company.

Another important aspect of CRM is the ability to provide direct customer service. As shown in Figure 6.29, ERP systems have self-service portals that enable customers to check on order status, pay bills, order new products, contact salespeople and account managers, check on company news and events, or ask for additional help. Although the page does not directly support XML, it does make it easy for customers to check on various transactions 24 hours a day. By encouraging customers to connect directly to your system, you obtain more accurate data and reduce costs. Of course, if your customer is the 800-pound gorilla in the industry, it is more likely that your salespeople will be spending time on the customer's ERP site.

Summarizing ERP Data

How can a manager handle all of the data in an ERP system?

ERP systems result in huge databases containing an enormous amount of data. Since the data represents all aspects of business transactions, it contains incredibly valuable information needed to make key business decisions. But, as a manager or executive, how do you find this information? Since it is stored in a relational DBMS, you could write queries to retrieve data. But, after a little time, you will see that you often need the same data every day—so you can compare the prog-

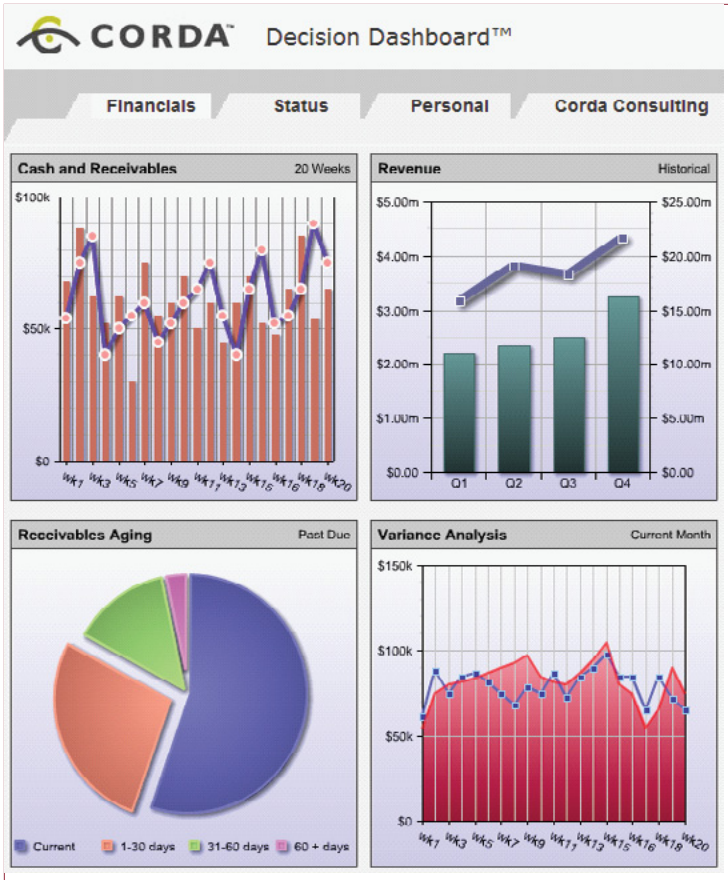


Figure 6.30

Digital dashboard example. Like the gauges on an automobile dashboard, the digital dashboard presents a top-level graphical representation of the status of various elements. Managers identify variables and choose from charts, gauges, icons, and tickers to display the data. Each item should be selectable to drill-down and provide more detail.

ress of common items. Consequently, many ERP systems have special tools to retrieve this standard data and display it in a graphical format.

Digital Dashboard and EIS

One of the major challenges to any information system is to make it easy to use. This process is complicated because the decisions need to be provided to upper-level managers who have little time to learn complex applications, yet deal with huge amounts of diverse data. One approach is to build a portal that displays key data and graphs on one page. The page retrieves data from a data warehouse, the Internet, or even machines within a factory and displays graphs and warnings. Toolkits exist to help build this **digital dashboard**. The older term for this approach is an **executive information system (EIS)**. Figure 6.30 shows a sample digital dashboard that with various charts designed to provide a quick overview of several key functions.

Reality Bytes: Cash is No Longer King

In the U.S. the Federal Reserve System is in charge of issuing and controlling cash. A study on the stock of small-denomination bills in use indicates that the use of cash reached a peak in the mid-1990s. Between 1995 and 2006, noncash transactions had increased from 250 a person to more than 300. Much of the shift has been to debit cards. But, it has been difficult for small vendors (or friends) to accept payments with cards—particularly without a storefront. A few companies, including PayPal, Intuit, and Square are trying to make it easier for people to make small payments without cash. For example, Square has a small credit card reader that plugs into the earphone jack of an iPhone or iPad. Processing costs for credit cards are relatively high and sometimes require monthly contracts. Square relies on per-transaction costs of 15 cents plus 2.75-3.5 percent of the transaction value. Apple and several other companies are trying to find new ways to transfer money. But any mechanism must be supported by both customers and vendors.

Adapted from Claire Cain Miller and Nick Bilton, "Cellphone Payments Offer Alternative to Cash," The New York Times, April 28, 2010.

Much like the dashboard on a car, the purpose of the main screen is to provide an overall picture of the status of the firm or a division or production plant. Managers can select the specific division and make comparisons to yesterday, last week, last month, or other locations. If there is a problem or a decision to be made, the executive can **drill down** to get more detailed data by pointing to another object. For example, if the main screen shows that current sales in the west region are low, the executive can focus on the west region and bring up the last few quarters of sales data. The EIS will graph the data to highlight trends. The manager can then dig deeper and bring up sales by departments or check the sales performance of each employee, highlighting unusually high or low sales figures. By pointing to customers, executives can get current profiles on the main customers and examine their recent purchases.

How Does an EIS Work?

For an EIS to work, it must be connected to the transaction-processing system or data warehouse, since it is the source of the data. Many of these systems are created with special software that simply grabs data from the corporate databases. In one sense, the EIS is a complex model of the firm. Figure 6.31 illustrates how executives can "visit" different divisions on the computer and retrieve the data immediately. For the EIS to be useful, the computer model must be a faithful representation of the actual company.

As a model, the EIS display has inputs of raw materials and people. Outputs are typically measured by traditional accounting standards of profits, costs, and growth rates. The EIS maintains budgets and forecasts and can compare them to actual values. The functions and processes are determined from the individual departments. For instance, there could be a production model that describes the manufacturing output. An EIS at McDonnell Douglas has a graphics screen that displays portions of airplanes as they are being built. As a wing is completed, it is drawn onto the computer model.

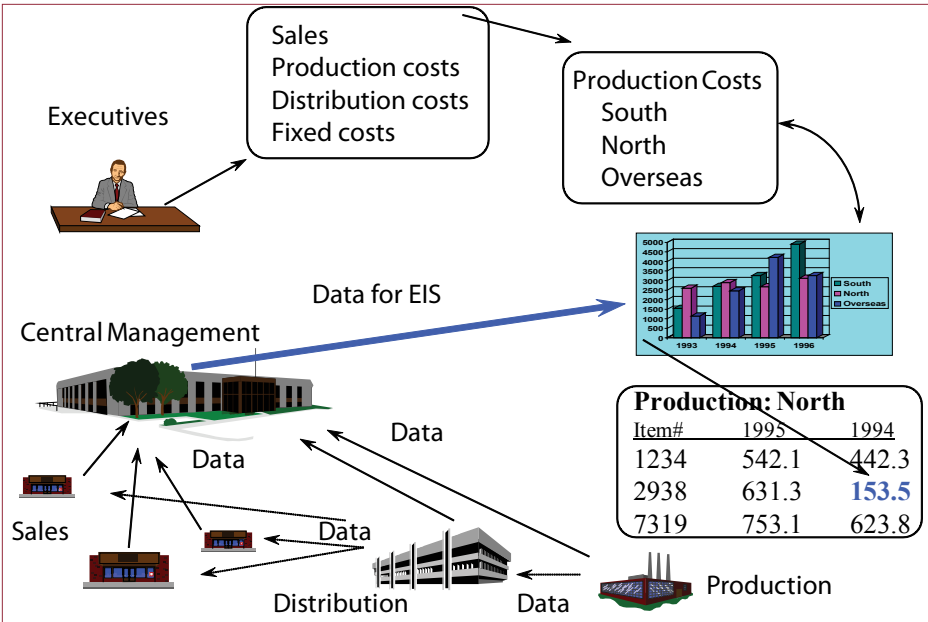


Figure 6.31

Executive information system. As industries become more competitive, managers search for ways to evaluate and improve the overall operations. Enterprise systems collect data from across the firm and make it available to managers and top executives. Executives can start with an overview of the firm and drill down to various levels and departments to get more detailed data.

Advantages of an EIS

The primary goal of an EIS is to provide easy access to corporate data for the executives. Instead of waiting for a report, the top executives can retrieve the data as soon as it is available. Also, because all the data is accessible from the same system, it is easier to examine data from different departments to produce a better view of the big picture. Another useful feature is that the executive's use of the data is nonintrusive.

Imagine that you are CEO of a company, and you do not have an EIS. The monthly reports have just indicated that one of the warehouses is not running smoothly. You want to find out what the problems are. You suspect the warehouse manager is part of the problem, but you need to be sure. What do you do? The most direct approach is to go visit the warehouse. But what happens when you show up at the warehouse? It is likely that the manager and the workers will change the way they work. Your attempts to collect data have altered the way the system runs, so you will not get the information you wanted.

Other options include sending other people or asking for additional information via the chain of command. Although useful, these methods will be slower and the information you receive will be colored by the perceptions of the people collecting the data. For example, many people will try to focus on what they think you want to hear.

Reality Bytes: Debit-Card Fee Cut

Overall, banks are in charge of the debit card and credit card systems. Technically, MasterCard and Visa are now independent companies, but they were created as agents of the largest banks to handle processing for credit and debit cards. Retailers who accept the cards pay fees to use the cards. In the U.S., fees for debit cards averaged from 1-2 percent of the transaction cost. These costs added up to an estimated $20 billion a year for U.S. merchants. And they were about twice as high as in Europe and other nations that regulate the fees. In 2010, Congress passed a law to limit the bank interchange fees charged for debit card purchases. The law took effect in July 2011 and essentially cut the fees in half. Banks expressed concern about losing a revenue stream and searched for ways to cut customer reward programs and increase other fees. Merchants would gain through lower costs and could either reduce prices or increase profits. Most economists were betting merchants would keep the extra profit.

Adapted from Miguel Bustillo, "Merchants Win Debit-Card Fee Battle," *The Wall Street Journal*, June 20, 2010.

The EIS minimizes these problems by providing instant access to the corporate data. The executives can produce reports and examine departments without interfering with the operations of the company. Graphs can be created automatically. The executives can set up different scenarios or simulations. Most of these activities are accomplished simply by pointing to objects on the screen.

Transaction Accuracy: Sarbanes-Oxley

How does the CEO know that financial records are correct? After several huge corporate scandals in 2001 and 2002 (Enron, Worldcom/MCI, Tyco, and so on), Congress decided to try and stop some of the problems. In particular, high-level executives were pleading innocent claiming that they did not know about the problems. So, they passed the Sarbanes-Oxley Act, which requires top executives of public companies to sign a statement attesting to the validity of the annual financial statements. So, how does the CEO know if the transaction data and reports are correct?

The solution proposed by the accounting standards board (AICPA) is to require more independent audits and reviews of the audits. Accounting audits examine all aspects of the transaction-processing system: from data collection, to data storage security, to accuracy of calculations and reports. Auditors also check physical assets (particularly bank accounts) to ensure that the numbers listed on the financial statements tie to real-world data. As shown in Figure 6.32, bank accounts are a critical element of auditing because they are maintained by external companies. Similarly, inventory and customer sales are at least sampled to ensure that they match against the internal financial records. These external numbers help anchor the internal statements. For example, it is hard to falsify the books if you have to match the cash balance at the bank. But not impossible. Somehow the Italian dairy company Parmalat managed to list $5 billion in cash in a Cayman Island account from 2002 to 2004 that did not exist.

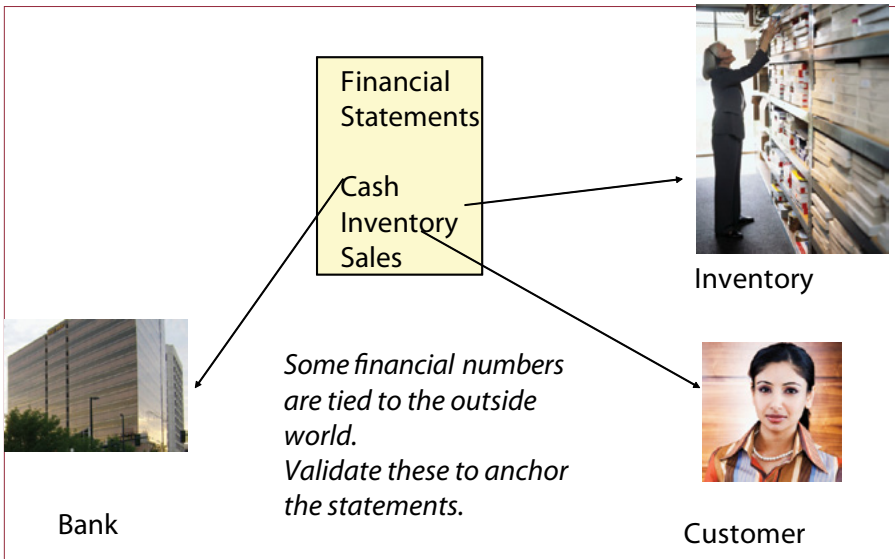


Figure 6.32

Financial audits. Verifying the quality of the data requires tying elements of the financial statements to externally validated numbers. Inventory can be physically counted. Customer sales can be sampled, and bank data must match the internal records.

Auditors also focus on the transaction and reporting processes. Do standard procedures encourage the timely and accurate recording of all data? Do people follow the standard procedure? The generally accepted accounting practices (GAAP) were created to establish standards and guidelines for accounting procedures. Today, one of the purposes of accounting software is to encode these practices into the system. In one sense, corporate accountants and managers are given less flexibility. Yet from management's perspective, the software encourages everyone in the firm to follow the proper procedures. Of course, some companies and managers will find these procedures too restrictive. Particularly if the company uses highly individualized practices and nonstandard production techniques.

One of the strengths of an ERP is the ability to define and enforce rules that apply to transactions. Accountants and auditors build the rules to maintain data integrity—often through separation of jobs. For instance, you can require a sales manager to verify all sales data entered by salespeople. Expenses can be automatically submitted to review by managers, and rules can be added to identify and flag unusual activity or high values. Receipt of supplies can be automatically checked against purchases Vendor identification and payments can be handled relatively automatically. Today's auditors spend considerable time evaluating ERP rules and procedures to ensure standard practices are followed to protect the integrity of the financial data.

Cloud Computing

Why do most companies avoid cloud computing for ERP systems? It is tempting to think that cloud computing would be a natural fit for ERP systems. The software is complex, and cloud systems could automatically main-

tain critical backup facilities for data and servers. Companies could access their data using simple computers with Web browsers from anywhere in the world. Because all companies need basic accounting and HRM software, it should be possible for vendors to provide online systems. And, several companies do provide these cloud-based services. NetSuite is one of the leading independent providers. The main vendors, including Oracle, SAP, and Lawson also provide options for hosting their software online. The primary benefit to online hosting is that companies need fewer initial resources and staff to maintain the hardware and software. Most of the costs become variable costs—largely based on the number of users.

However, many companies have avoided using cloud computing for their primary accounting ERP systems. Some of the reasons include concerns about security, privacy, and reliability. Cost, and the perception of cost, is also an important issue. Most ERP systems require customization—regardless of whether the system is online or run internally. These costs can be a significant portion of ERP design and implementation. Managers are also leery of variable costs based on the number of users. Most managers expect (wish) their company to grow—so they anticipate increases in the number of future users. With in-house, fixed systems, this growth generally does not cost extra money for the ERP (until hardware has to be scaled up with large increases). With cloud-based systems, managers anticipate increased costs every year, so they perceive costs as lower with their own system.

Large companies generally built their own systems and hired personnel to maintain them before the cloud-based systems became available. It would be difficult for them to justify switching—particularly if switching requires recreating the customized components. Consequently, most cloud systems target small and mid-size businesses. Yet, small businesses are likely to have minimal accounting systems and rely on simple systems and probably a single accountant. They are unlikely to see much benefit from an online system that requires continual monthly payments.

Another factor in holding back online systems is that browser-based ERPs are relatively new. Plus, mobile Internet connections—particularly in the U.S.—have been relatively slow and expensive. As ERP software, networks, and mobile technologies improve, more businesses might see a value in using online systems.

One area that has attracted companies is CRM. Salesforce.com has been relatively popular and experienced high growth rates. However, many companies treat their Salesforce data independently from their ERP data. It is largely used as a contact-management system. Salespeople use the system to share contacts and notes with others in their company. But, this data is probably not connected to in-house data including production and shipping—unless people manually transfer the information. Still, these cloud-based CRM systems appear to provide benefits to companies and salespeople so they continue to use them until more integrated tools become available.

Summary

Every organization must perform certain basic operations: pay employees, manufacture products or services, pay bills, monitor revenue, and file government reports. Operations are relatively structured, short term, and easy to computerize. They form the foundation of the company. MIS supports operations by collecting data and helping to control the underlying processes. Transaction-processing systems are responsible for capturing, storing, and providing access to the basic data of the organization. The goal is to capture the transaction data as soon as possible.

Common collection methods include point-of-sale devices, process control, electronic data interchange, and electronic commerce Web sites. Because data is the foundation for all other decisions, transaction-processing systems must maintain data integrity and minimize the threats to the data.

Even when the firm has production and sales in multiple nations, ERP software makes it possible for managers and executives to get a complete up-to-date picture of the entire company. Equally important, this level of integration makes it possible to change the way the company operates. Instead of relying on mass production to lower costs, companies can focus on the customer and the market. Working from the customer perspective, the firm can produce the items and options desired by the market. This type of production is possible because the information is instantly available to production and to suppliers. Integrated data on customers improves relationships with customers by enabling companies to identify client needs and respond to problems faster.

Integrating accounting, production, sales, and employee data makes it easier to identify bottlenecks, identify and reward the best employees, and gain a competitive advantage. Ultimately, the key to ERP systems is not the software—it is the integration and reengineering of the business operations that make your company better. The tools provide the ability to change the way the firm operates, and to use these capabilities to find a better overall solution. Whether the firm manufactures products or is a service firm or governmental agency, you can find new ways to operate when everything is integrated.

A Manager's View

How do you keep up with the thousands or millions of transactions in a modern organization? Information systems have been developed to handle internal data from accounting, human resource management, and production. Enterprise systems integrate the many pieces into data that is consistent and accessible across the organization. Increasingly, it is possible to interact electronically with other companies. These systems make it easier to identify and interact with your customers and suppliers. The integration makes it possible to alter the way the company is structured and managed. Creating agile firms that use mass customization to deliver exactly what the customer wants at costs comparable to those experienced with mass production.

Key Words

accounting journal
audit trail
bill of materials
chart of accounts
continuous quality improvement
customer relationship management (CRM)
digital dashboard
distribution center (DC)
drill down
electronic data interchange (EDI)
enterprise resource planning (ERP)
exception reports
executive information system (EIS)
extensible markup language (XML)
extensible business reporting language (XBRL)
general ledger
just-in-time (JIT)
magnetic ink character recognition (MICR)
mass customization
optical character recognition (OCR)
point of sale (POS)
process control
radio frequency identification (RFID)
request for proposal (RFP)
supply chain management (SCM)
transaction processing

Web Site References

General Travel Reservations	
Expedia	www.expedia.com
Kayak	www.kayak.com
Orbitz	www.orbitz.com
Sabre Travelocity	www.travelocity.com
Discounts	
Bestfares	www.bestfares.com
Cheap Tickets	www.cheaptickets.com
Priceline	www.priceline.com
TravelHUB	www.travelhub.com
Individual Airlines (U.S.)	
Alaska/Horizon	www.alaskaair.com
American	www.aa.com
Delta	www.delta.com
Frontier	www.frontierairlines.com
Jet Blue	www.jetblue.com
Southwest	www.southwest.com
United	www.ual.com
US Airways	www.usairways.com

Review Questions

1. Describe four methods of data capture.
2. What is the role of XML in EDI transactions?
3. What is the purpose of XBRL?
4. Explain how to a vendor all payment methods have costs.
5. Why are customers unlikely to adopt a new payment mechanism?
6. How do accounting and financial systems form the backbone of ERP systems?
7. Why are human resource management systems such an important component of ERP systems?
8. How are distribution centers used to reduce inventory, and what information is needed for them to operate efficiently?
9. What is the role of a DBMS in an enterprise resource planning system?
10. What are the primary features and capabilities of an enterprise resource planning system?
11. How does supply chain management enable a firm to change its structure and focus?
12. Why is customer relationship management so important? Why does it require an integrated system?
13. Why is an executive information system or digital dashboard so important to an ERP system?
14. If you start a new company, would you use cloud computing to handle your accounting system? Why or why not?

Exercises

1. Choose 10 Web sites that sell items or content. Create a table and identify the payment methods that they support.
2. In 2010 and 2011, a few cell phone companies tried to create a new standard to enable people to pay for items with their cell phones. Why did that project fall apart? What alternative, but similar method is being pushed?
3. Identify the primary government laws and rules that are designed to protect the government's interest in transactions.
4. Assume that you are running a small manufacturing business. To reduce costs, you want to contract with an overseas manufacturer to build a key component. How would you locate a company do to the work? What transaction details and data sharing will you have to set up to make the process work?
5. Find a balance sheet and income statement for a company (Try the EDGAR system at www.sec.gov). Rebuild the two statements as separate pages in a spreadsheet.

C06E06Base.mdb

6. Create the basic forms needed to use the database in a transaction system.
7. Create the spreadsheet in Figure 6.19 that shows the initial integration. The database file contains the basic data. You should build queries and import the data into a spreadsheet to create the analysis and charts. It is best if you use dynamic links.
8. If you have access to an ERP system, take a specific role (salesperson, production manager, customer, supplier, etc.) and use the system to enter data and check on the current status variables for your role.
9. Choose an industry (for example, automobiles, bicycles, or spare parts). Research the industry and identify what aspects follow mass production versus what operations follow mass customization strategies. Identify whether the industry sells predominantly to consumers or other businesses.
10. Find two cloud-based accounting systems that could be used by a business with revenues of about $1 million a year and 50 employees. If possible, estimate the costs of the systems. Pick one and explain why it is better than the other.

Technology Toolbox

11. Find information on at least two accounting or ERP packages that could be used for a business with 100 to 150 employees. Identify the strengths and weaknesses of each package. Are the packages tailored to specific industries?
12. You need to select an accounting or ERP package for a small service business, such as a law firm or accounting firm. Identify the major features that you want to see in the accounting system.
13. You have been hired as a consultant to a small graphics design firm with 20 employees. Design a digital dashboard for the owner-manager to monitor the important variables of the company.
14. Compare the purchasing capabilities offered by two ERP vendors. Visit their Web sites and view the demos. If possible, include copies of the main purchasing forms from each vendor. Summarize the similarities and differences.
15. Find an organization that uses a digital dashboard-executive information system. Identify the major components on the main screen, and briefly explain how the system is used to drill down to additional information.

Teamwork

16. As a team, find at least 10 Web sites that deal with international customers and point out the features that they provide that might not exist or are different on typical American Web sites.
17. Assume you want to create a customer relationship management system for a company that sells supplies and products to hair salons. Each team member

should find one CRM product then identify the strengths and weaknesses for this task. Combine the results and select one tool to recommend to management.

18. Each team member should research one ERP system. Identify the internationalization features available. Assume you are running a midsize company with offices and operations in several European nations. Describe the benefits provided by these international features. Make a recommendation on which product to buy.
19. As a team, research the status of XBRL in financial reporting. Identify which organizations require its use, which tools can generate XBRL reports, which tools exist to retrieve and analyze XBRL data, and so on.
20. You have been hired as a consultant to a midsize agricultural company that packs fruit and ships it to retail outlets. The fruit is grown under contract at regional farms. About 65 percent is sold to grocery and chains and fruit stores in the United States, while the rest is shipped overseas to high-end stores and restaurants. Design an ERP system with a digital dashboard for this company. Assign individual components to each team member. Be sure to identify potential problems and risks that might arise.

Rolling Thunder Database

21. Identify the major transaction-processing components in the system.
22. What features are used in the database and the forms to ensure quality of transaction data?
23. For each major transaction type, identify the sequence of steps that are performed and determine which ones are time critical.
24. For each major transaction type, estimate the frequency of the transaction and the volume of data involved.
25. Using the existing forms, perform the following tasks for Rolling Thunder:
    a. Take a bicycle order.
    b. Assemble a bicycle.
    c. Create a new purchase order.
    d. Record the receipt of purchases.
26. Extract sales and cost data by model type and create a spreadsheet to analyze it. (Hint: Use the Extract Data form.) Write a short report discussing profitability and any trends. Include graphs to illustrate your comments. Your spreadsheet should look at monthly sales by model and monthly material costs by model. Be sure to compute profit margins and examine percentages.

27. Assume that Rolling Thunder is experiencing problems with quality control. Suddenly there are several complaints about the components. Write a report describing all of the data and reports we would need to help us resolve these problems.

28. Top management needs an analysis of purchases and deliveries from vendors. Begin by using queries to extract the appropriate data to create a basic spreadsheet. Write a report analyzing the data; include graphs to illustrate your points.

Vendor	Purchases Order total $	Percent of vendor total	Received $	Receipts % of purchase	Avg. # days to deliver

29. Describe how an ERP solution could improve operations at Rolling Thunder. What operations would you implement first?
30. Describe how Rolling Thunder Bicycles might use a supply chain management system. In particular, how would it integrate with its suppliers?
31. Describe or create a subsystem that could be used by the head of sales management to monitor and improve customer relationships and sales.

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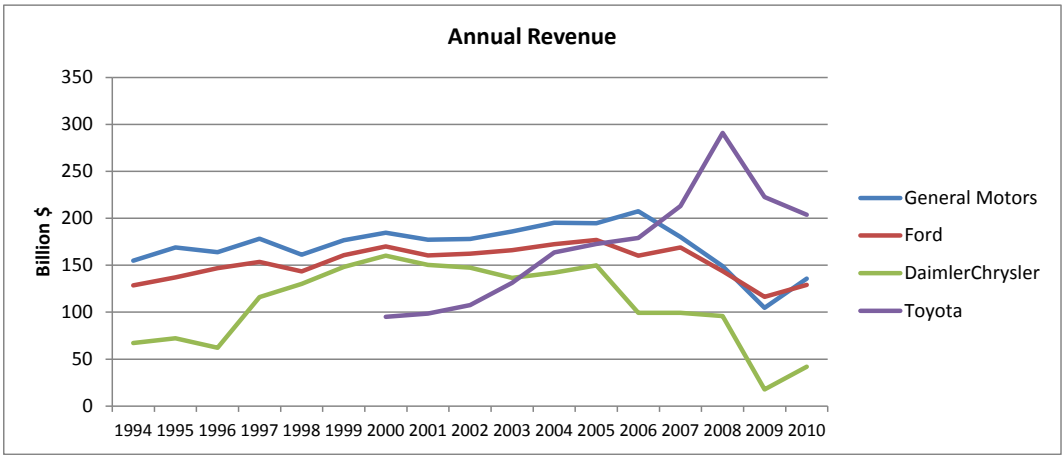
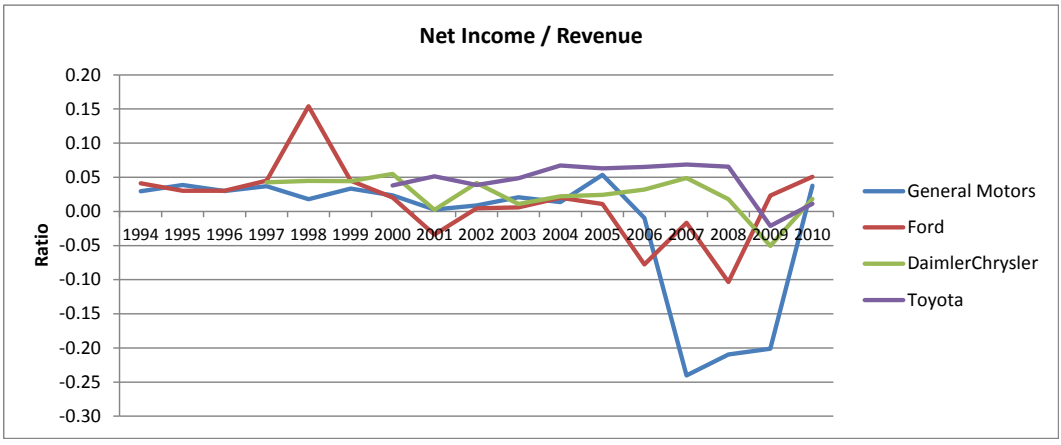
Cases: Automobile Industry

The Industry





Automobiles remain one of the most expensive, complex products sold to consumers. Manufacturing requires thousands of steps with parts acquired from hundreds of suppliers. And people buy cars for more than transportation—they are purchased based on image and style. As Ralph Szygenda, legendary CIO of GM puts it: "GM is ultimately in the fashion business, and to win, the company needs the best cars and trucks, which we have, with more to come" (Szygenda 2003). Perhaps he was a bit optimistic. North American sales for 2003 dropped to 16.6 million vehicles. GM had the largest market share at 28.3 percent, followed by

Ford (20.7), DaimlerChrysler (12.8), Toyota (11.1), and Honda (8.1) (Warner 2004). The astonishing number is found in the 1960s when GM's market share was over 50 percent. However, the declining share is not all that it seems. Check the Web sites of the big three companies and you will quickly see that they have bought up several other brands over the past years. Dig a little deeper into GM's annual report and you will find that the company at one time owned shares in Subaru, Suzuki, Fiat, and Daewoo, among others. Ford has similar arrangements with other companies. By 2010, the total U.S. market share for the big three manufacturers (GM, Ford, Chrysler) was only 45 percent.

Company	2010 YTD/May		Company	2010 YTD/May
GM	19.1		Hyundai	4.4
Ford	16.9		Mazda	2.1
Chrysler	9.4		Subaru	2.3
Toyota	15.2		Mercedes-Benz	1.9
Honda	10.5		BMW	1.8
Nissan	8.1			

Market Share: http://online.wsj.com/mdc/public/page/2_3022-autosales.html#autosalesE

Most of the firms in the industry also faced a huge problem they referred to as legacy costs. Over the years, the heavily unionized American firms promised huge pensions and health care benefits to their employees. Now, they face billions of dollars in fixed cost payments to retirees—costs that were never fully funded from prior operations. So, a substantial percentage of current sales revenue went to paying these costs.

Competition

In general, the industry is highly competitive. It has been estimated that the Detroit big three have an excess production capacity of 2.5 million vehicles (Plunkett Research). Total U.S. sales fell slightly in 2003 to 16.6 million new vehicles. Compounding the problem is the fact that many of the sales have been driven by deep discounts—either in price or in financing deals. At one point, in 1993, Ford pushed so hard to make the Taurus the number one selling car, that it was giving discounts of $2,600—a considerable sum at the time. Most observers believe Ford was losing money on every car (White 2004).

At the same time that the American car companies appear to be suffering, it should be noted that only 40 percent of Americans can actually afford to buy new cars (National Independent Dealers Association). In 2001, the Bureau of Transportation Statistics reported sales of 8.6 million new passenger cars (not trucks) and 40.7 million used passenger cars (and 11 million new bicycles) (www.bts.gov). Used truck numbers are not reported, but in terms of new vehicles, cars make up about 50 percent of the total number of vehicles. In any case, sales of new vehicles account for about 17 percent of automobile sales. Globally, about 60 million vehicles were sold in 2003 (GM annual report).

Sales of American vehicles have continued their decline. In 2007 Ford experienced an 8.1 percent drop in sales, Chrysler Group sales fell 1.4 percent, and GM sales dropped by 21 percent. In contrast, most import manufacturers reported double-digit increases in sales (Lam 2007). Ford and GM both reported that part

of the decline was due to a reduction in sales to car rental fleets. The manufacturers are trying to move away from these low-margin sales. Sales were also down for most other months in early 2007. The domestic manufacturers announced sales promotions for July. Also in 2007, Daimler, the German parent company announced the sale of Chrysler to a private equity firm. The U.S. auto industry also faced huge pension-fund and health care costs that were promised to workers and retirees decades ago.

Technology and Management

The ultimate question the automobile industry faces is: How do you manage such a large, complex company? In 2003, GM had 326,000 employees worldwide, and revenues of $185 billion (annual report). The company ran 32 plants in North America alone (Garsten 2003). By 2010, the number of employees was down to 202,000 (2010 annual report). With multiple divisions, thousands of designers and engineers, and a recalcitrant union, how can anyone possibly determine what is going on, much less control it? As one of the largest companies in America for over 60 years, GM is an interesting case in management and mismanagement. The company was initially created by combining several independent brands. Alfred P. Sloan, who organized and ran the company in the 1930s, knew that with the information system available at the time, he could never control an organization that big. His decision was to let the divisions run somewhat independently, but report to a set of policy committees and central staffs in a system he called "decentralized operations and responsibilities with coordinated control" (Taylor 2004). All auto manufacturers have struggled in the last couple of decades with the question of how to control the huge organizations. As technology has improved, new options have been created that provide for increased central control across the entire organization. Tools such as global networks, CAD-CAM systems for engineers, workgroup and collaboration systems for managers, and enterprise resource planning systems for operations and finance make it possible to share data. Yet installing these systems is only the first step. It is also necessary to change the way the company runs. And that can be difficult in an organization used to flexibility and defined ways of functioning that evolved over decades.

The automobile manufacturers have tested many variations of information technology over the past decade. The industry spent billions of dollars on telematics (integrating information systems into the vehicle). It has spent billions more on supply chain management and enterprise resource planning systems. Today, most of the $3 billion a year that GM and Ford spend on IT goes to operations—keeping the existing systems running (Piszczalski 2002). The companies have still not achieved total integration of their systems, and might never reach that state. But they are still interested in tools that can solve specific problems and provide gains in quality, cost reduction, and bringing new models to market faster.

In 2007, Ford announced a partnership with Microsoft to install an integrated in-car communication and entertainment system. The system has USB and Bluetooth ports for establishing connections to most consumer electronic devices. It also supports voice-activated calling—increasingly important as more states ban hands-on cell phone use in cars (Rosencrance 2007).

The Crash of 2008

The recession of 2008 was the last straw for GM, and the company filed for bankruptcy on June 1, 2009. In the process, the U.S. and Canadian governments bailed

out GM (and Chrysler) with billion-dollar infusions of cash. In exchange, the two governments gained partial ownership rights to the two companies. Ford had fortuitously refinanced several loans right before the crash and was able to avoid the financial crunch and did not file bankruptcy or require government subsidies. In the cleanup process, GM shed most of its "legacy costs," by creating a new company that holds mostly newer assets and dropped the pension fund obligations. In exchange, the unions gained control over most of the new GM shares. In November and December 2010, the new GM issued an IPO and became the new GM (2010 Annual Report). Chrysler was sold to Fiat, the Italian car company. Ford remains as an independent company. Both GM and Ford sold off or closed several car divisions. For example, GM closed Hummer, Pontiac, and Saturn, and discarded Saab; leaving the company with Chevrolet, Buick, Cadillac, and GMC in the United States. Ford sold Jaguar and Land Rover to Tata Motors and closed the Mercury division.

The other big changes in the industry stem from the rising price of gasoline in 2010—hitting over $4 per gallon in most states in 2010 and 2011. This price level encouraged people to search for cars with better gas mileage—particularly hybrid gas/electric cars. Although the American companies had some hybrid cars available, the Toyota Prius was the industry leader by a long shot. In 2011, GM began selling a hybrid car that could run 40 miles on electric power, and Nissan introduced the Leaf—an all-electric car. Huge uncertainty remained over whether customers would buy all-electric cars and whether it would be possible for the cars to have a long enough range to be useful as a primary vehicle.

The third overall trend is that total sales outside the U.S. exceed the value of sales within the U.S. By 2011, China had become the largest automobile market in terms of the number of vehicles sold. For example, GM sold 8.4 million vehicles worldwide in 2010 and 2.2 million in the U.S. The total industry sales in the U.S. were 11.8 million, and total worldwide sales were 73.6 million (GM 2010 Annual Report). Worldwide, Toyota was the largest automobile manufacturer in 2010.

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Case: Ford

Ford (ticker: F) has presented several interesting cases in management over the years. Driven initially by Henry Ford's efficient adoption of mass production, the company dominated the automobile industry. Through all of the changes in the industry, technology, and finance, the company has largely remained under the control of the Ford family (40 percent of the voting stock). In October 2001, the family ousted Jacques Nasser and Henry's great-grandson, Bill Ford became CEO. The firm struggled for a year, trying to recover from its earlier problems. One of the major changes implemented by Mr. Ford was an emphasis on profits—instead of raw sales numbers. Toyota is close to overtaking Ford and becoming the number two car company in the United States. Mr. Ford's comment: "I don't want to be the biggest. I want to be the best." With lower sales, Ford surpassed GM in profits for 2003 (White and Shiorouzo 2004).

Revenue Decisions

The automobile industry is a classic case of mass production. Building thousands of identical cars and trucks reduces costs. But then you have to sell them. Does everyone want the exact same car or truck? In 2001 and 2002, Ford began to re-evaluate its strategy, with a focus on identifying the source of profits. Why build 300,000 Tauruses if the company loses money on each car? In the process, the company found that it needed to track exactly which vehicles are selling, what features are in demand, and the details of regional preferences. Bill Ford promoted Lloyd Hansen to a corporate vice presidency in charge of overseeing revenue management—identifying exactly which products should be built. The company began analyzing data from existing sales channels. More important, it combined consumer Internet research data to identify regional choices. Mr. Hansen says that the company was surprised to find consumers in sunny states were interested in four-wheel drive pickups. "There was always this gut-feel paradigm that people who live in Texas, Florida, and California don't need a 4-by-4" (White and Shiorouzo 2004). By sharing the data with dealers, Ford increased shipments of the more expensive trucks. Ford uses the same information analysis to target discounts more precisely. With truck sales, Ford was able to increase revenue by $934 per vehicle from 2003 to 2004 (Taylor June 2004).

Think about the decisions required for revenue management. The key is that you have to decide exactly which products to produce tomorrow. You have dozens of cars and trucks, each with several trim variations. You have dozens of plants. You have some data on sales and profits. Should you produce 1,000 Ford Explorers that might generate $4,000 per vehicle in profits, or should you run 1,000 Focuses with lower profit margins. If you do run the Explorers, how much discounts

should you give to get them sold? Keep in mind that this is a $25 million decision that you have to make every day (White 2002).

Now, make the process even more complicated: what are your rivals going to do? If Cadillac offers a rebate on the Escalade, how will that affect sales of the Navigator? Should you match the discount, or accept the possibility of lower sales at higher profit margins? What is the probability that Cadillac will offer that rebate? More importantly, if you respond, will they retaliate and offer even larger discounts? Few models are actually this sophisticated today, but in reality, you need to forecast a huge number of variables to make these decisions.

Production Management

The system of mass production makes it difficult to respond to changes in demand. Forecasts are helpful, but Ford has worked hard to add flexibility into its production system. In particular, it is working to build different versions of cars from the same plant. At one time, each plant was designed to produce only one type of car. Today, plants need to be able to switch production so that when demand for crossover wagons increases, the company can stop producing sedans and build the high-demand cars instead. Toyota and Honda pioneered these practices, and Ford is still trying to catch up, but the company is making progress. Many of these changes are being implemented in the new Chinese plants. The goal is to put in only enough capacity to meet current demand, but enable the plants to expand quickly if demand takes off (White and Shirouzo 2004).

Of course, it always pays to improve efficiency in production. Ford's plant in Cuautitlan, Mexico, produces 300,000 to 400,000 cars and trucks a year. It uses a just-in-time production system, where suppliers deliver parts as they are needed on the line—instead of holding them in inventory. Until 2002, the partially completed vehicles were tracked through manufacturing and painting using paper identification sheets. But this manual system generated huge numbers of errors from lost, damaged, or switched sheets. Ford called on Escort Memory Systems from California and CAPTA from Mexico to convert the system using radio frequency identification (RFID) tags. Dealing with the electronically dirty manufacturing floor and the 220° C paint oven temperatures was a problem. The companies used high-temperature RFID tags with 48-byte memory and 1,200 bytes/second transfer rate. The tags were attached to the pallets that carry the vehicle bodies through the plant. Antennae were embedded in explosion-proof containers in the floor under the conveyor belts. As each skid passes over an antenna, the system reads it and feeds the information to the central control system (Johnson 2002). In 2004, ford installed WhereNet Corp.'s real-time parts-locating system in its F-150 truck plant. The system changes production from a push-based inventory supply to one that pulls products onto the line when an operator pushes a button. The system knows which parts are needed and delivers them to the job site just as they are needed (Rosencrance 2004).

In a fashion market, producing new models quickly is critical. Ford has reduced its development time by 25 percent from the late 1990s and is getting better by 10 percent a year. Still slower than Toyota, but Ford was able to produce a third of its new models in 30 months or less (Taylor February 2004).

Turnaround

Ford weathered the recession and liquidity crisis that took down GM and Chrysler, but it faced many of the same pressures in terms of lost sales and restructuring.

CIO Nick Smither arrived at Ford before the 2008 crisis, but Ford had already slashed costs and dropped models. Smither noted that "I have always said a career in IT is a career in change management. But no one could have anticipated this level of change" (Johnson 2010).

One of the changes at Ford was to simplify production and ordering—by reducing the number of configurations. For example, up to 2008, a customer could order a full-size SUV with one of 76,000 configurations. By 2010, the list was cut to 1,500. Not exactly simple, but easier to produce. Ford also reduced the number of vehicle platforms, from 27 down to 15; and it wants to use those for all global production. IT costs have also been slashed, and Smither focused on removing excess capacity and duplication. It dropped from six data centers down to four and cut the application portfolio by 40 percent. The company added new collaboration tools and built standardized systems to support integrated design, procurement, sales, marketing, and manufacturing processes. It also developed new in-vehicle communication and entertainment systems. All while cutting IT staffing by 20 percent (Overby 2010). The CIO now reports to the CEO and meets weekly with corporate executives to restructure the entire company into a single system. For example, a new WebQuote system is used by all engineers in Ford to define products and solicit quotes—from any division around the world. Everyone sees the same data and same suppliers.

In cooperation with Microsoft, IT also developed the in-vehicle Sync system that integrates and controls everything from the radio, to seats, to the navigation system. It is largely voice-controlled and is highly praised by most customers.

Questions

1. How does Ford's information system help them reduce costs and add flexibility to the production line?
2. What data is provided by the ERP system that can be used to make tactical and strategic decisions?
3. What type of data does Ford need to know to build its forecasts and plan production levels? How does the ERP system provide this data?

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Case: General Motors

General Motors (ticker: GM) began life as a diverse company—a collection of manufacturers loosely controlled through a central organization. It really has not changed much over the years, but it keeps trying. Even the bankruptcy filing and "new" GM did not actually change the management structure—although it did bring in a couple of "outsiders" as CEOs.

Product Management and Marketing

The "old" GM listed nine major brands on its home page (without Buick). And that list does not include several European and Asian brands that are fully or partly owned by GM, such as Opel, Vauxhall, Daewoo, Fiat, Isuzu, and Suzuki (Plunkett Research 2004). Imagine trying to monitor the dozens of companies, product lines, and markets. One step GM is taking is an attempt to build a central European database encompassing clean data from Spain, the Netherlands, and the UK. Most of the work is being done for its Daewoo division. The goal is to create a consistent list of its 700,000 customers and prospects and make it available from its Amsterdam headquarters. Daewoo's UK direct marketing and e-commerce manager, Matthew Young, notes: "In Europe, it was apparent that we had no continuity or integration of style. This will also plug the hole in our cost efficiency" (GM Daewoo 2004). The "new" GM was down to four domestic brands, plus ownership in several international companies (2010 Annual Report).

Production and Collaboration

Production of automobiles is changing—particularly as the automotive technology changes. For example, the gas pedal in the 2004 Corvette is not mechanically connected to the engine. Instead, it is an electronic connection—much like the fly-by-wire Boeing 777 jet. Many cars have 30 wireless sensors in them, with plans for new models with over 50 devices in them. Tony Scott, chief technology officer at GM, notes that "we spend more per vehicle on software than we do on steel," and that software has to survive the 10-or-more-year life of the car (Sullivan 2003).

Implementing new technologies into automobiles is a complex task. Advances have to be evaluated, tested, and priced to match the level of the automobile. To handle the changing technologies and track which ones are being used in each vehicle, GM adapted a technology road mapping process developed at Saab (at one time a subsidiary of GM). The basic process places the model year on the X-axis of a chart, and the Y-axis represents increasing performance. Individual projects are drawn on the chart to show if they are funded or unfunded, and when they started. Collecting the data for charts across the organization was not easy. Eventually, a database-driven Web site was created to hold the information about existing and planned projects, containing the description, budget, development stage, key personnel, cost, and planned applications. Even then, most divisions were reluctant to enter the appropriate data. So, GM forced divisions to enter data by explaining that if there was no data in the database, then the project must not be important, and it would not be funded. The process was useful for some groups, but avoided by others. The good news is that everyone could see how the various projects scattered across the company were related. For example, electronic steering was going to rely on the 42-volt electrical system (older cars use a 12-volt system), so the timing of the two projects had to match. The system also showed several redundant projects, which caused conflicts because everyone wanted the

"other" project to be canceled (Grossman 2004). A powerful extension of the road mapping process was to extend it to suppliers. For example, by overlaying Motorola's road map, engineers could plan for future capabilities.

Automobile manufacturers are really assemblers and integrators. Each plant has thousands of suppliers who provide everything from individual bolts and glue to fully assembled cockpits and seats. Each of these companies has additional suppliers. How can anyone track the orders and solve problems if something goes wrong several layers deep into the supply chain? Product life cycle management (PLM) software presents one answer that is being used in the automotive world. The system enables GM to track the source of all components used in a product during its lifetime. It also provides information to the supply chain participants. Terry S. Kline, GM's global product development process information officer, notes that "in product development, IT projects like PLM have helped pare a billion dollars of cost over the past three years." But Kline also quickly notes that the system has also helped reduce the time-to-market from idea to product from 48 months to 18 months (Teresko 2004). About 80 percent of a car and as much as 70 percent of the design content comes from outside the automobile company. PLM integrates the business information with the engineering (computer integrated manufacturing) data and shares it with other members of the supply chain.

Making the thousands of decisions and setting strategy is incredibly difficult. Rick Wagoner, the CEO, noted in 2004 that "we didn't do everything right over the last 12 years. About three times during that period you think you've got it, and then something else comes up. We made huge progress in '92, '93, '94, but then we started to pay the price because we had, out of necessity, underspent (on new products) during that tight period and didn't do that well on the revenue side. Then, in the last three or four years, we've run the business very well, but the pricing has been tough. So my lesson—these aren't complaints but an observation—is, Don't ever think you've got it licked, because you probably don't. This is not a one-step game. This is a multiple[-year] thing, and it's hard, and you learn as you go along. The key thing is to remember what you've learned so you don't have to relearn it" (Taylor 2004).

In early 2007, GM signed a $1 billion five-year contract with AT&T to provide global IP services supporting voice, data, and video communications around the world. The system provides a global virtual private network for GM based on Multiprotocol Label Switching (MPLS) that supports routing packets by priority values. Ralph Syzgenda, CIO at GM, stated that "The real end goal is that every employee has the same type of capabilities no matter where they are in the world, and in fact, when they wake up, they don't need to know where they are in the world. It just works." (Thibodeau 2007).

Technology in cars is also increasing. In 1990, a typical car ran software consisting of one million lines of code. By 2010, the number is expected to increase to 100 million lines. Software and electronics in 2004 constituted one-third the cost of the car. GM is concerned about managing the software development process and the liability. Anthony Scott, chief technology officer for GM's Information Systems and Services organization said that "People love to sue GM when they get into an accident or have some sort of a problem. As more and more software comes into the car GM is going to expect [software developers] to participate at some level in that liability." (McMillan 2004).

Information Technology

Ralph Szygenda is already a legend at GM. As its first CIO in 1996, he inherited several problems. GM had tried to simplify its IT functions by outsourcing computer management to EDS—of course, the company wanted to keep the profits, so it purchased EDS. But the IT departments were still not running smoothly. Among other problems, it took the company 48 months to develop a new car. Szygenda went several steps further into outsourcing—by moving to a multivendor approach, forcing them to compete against each other, yet still cooperate to provide products that worked together. In the process, he slashed annual IT spending from $4 billion to $3 billion, and installed 3-D virtual reality modeling software along with a collaborative infrastructure. Model development time dropped to 24 months. The time it takes to deliver a special-ordered vehicle dropped from 70 to 30 days. To control the outsourced components, Szygenda kept 2,000 IT managers in house. He observes that "when I first started doing this, people said you couldn't outsource critical aspects of the company, and I agree with that. Those 2,000 [managers] are the critical part, but the hands, arms, and legs of building IT can be outsourced" (Zarley 2003). Szygenda uses the 800-pound gorilla clout of GM to keep suppliers in line and encourage them to adopt standard procedures.

A frustrating problem for customers arises when they take a vehicle to the dealer for a repair, but the dealer does not have the repair parts in stock. Dealers do not like to carry large inventories because the carrying costs are too high. GM maintains an inventory of 1.3 million parts and dealers typically stock from 5,000-12,000 parts. In the past, GM relied on the judgment of individual dealer parts managers, who waited until the end of the week to submit a batch parts order. The practice also caused problems for GM distribution centers as workers rushed to fill orders from hundreds of dealers arriving at the same time. To reduce the problems, GM installed a Retail Inventory Management (RIM) system that tracks daily parts usage at each dealer. The data is sent to the regional distribution center and replacement parts are shipped to the dealer. A pilot test involving 350 dealers in Florida resulted in a smoother work load with an order variance of 2 percent compared to 21 percent before installing the system. The system also uses analytics to recommend which parts to stock at each dealership. GM's Saturn division had used a similar system for years, but it was a challenge to build the new system to integrate thousands of dealers using diverse systems (Thibodeau 2006)

Technology has not always been successful at GM. In the 1990s, it installed a computerized system for dealers that required them to order cars 90 days in advance, and it made it difficult to change orders. In the meantime, GM announced that it wanted to take over 700 dealerships and run them centrally. Then, the ordering system crashed and sales plummeted for a month. The system was eventually fixed, but the two decisions alienated dealers. Jack Smith, ex-CEO of GM, notes that these and other problems were exacerbated by market manager Ron Zarrella, who was brought in as an outsider from Bausch & Lomb. Smith notes that the car business is unique, and an outsider might say, "'That's really a dumb way to run." But the unfortunate thing is, that is the way it runs. There are some things you just have to live with (Taylor 2004).

GM, and other companies have begun experimenting with RFID tags to track parts through the supply chain and factory. For example, GM uses active RFID tags to store job information to indicate which parts need to be installed in each vehicle. But the company is still focused on using bar codes to track parts. Bar codes are substantially cheaper and are not subject to electrical interference from

metals and chemicals on the production floor. Engineers do believe passive tags could be useful within the car, making it easy for repair people to quickly scan for the exact part installed deep in a vehicle (Weier 2006).

As one of the largest organizations in the world with plants and offices in 200 countries, 280,000 employees, thousands of dealers, and millions of customers, GM has an identity problem. GM has tried federating identity management systems from several companies, including tools from Novell, Siemens, Oracle, and Sun Microsystems. But James Heaton, global director of identity management said that "a lot of vendor solutions halfway work for GM, but when we try to scale them, they break. We break almost everything we touch the first time we try to use it." Even creating a system that handles password resets is challenging—particularly with multiple languages. If a user forgets a password, the system asks personal questions to identify the user and reset the password. When the system was installed, GM saw problems spike in Portugal and Brazil. One caller complained "I did everything the system told me to until I came to the validation questions about my goat. I don't have a goat." Obviously there was a translation error in the system, but it takes time and resources to spot the problems and fix them. The process is complicated because GM has 2,481 applications that require authentication (Babcock 2007).

In 2009, GM tried an experiment by auctioning a new car on eBay. The site allowed California buyers to place online bids for cars from 225 of the 250 dealers in California. A J.D. Power & Associates study had noted that 70 percent of buyers use the Internet for research before buying a car. The initial auction was successful, but most dealers already use the Internet and even eBay for sales—particularly for used cars (Barris 2009).

Near the end of 2009, Terry Kline became the CIO of General Motors when Ralph Szygenda retired. One of Kline's first goals was to upgrade desktops to Windows 7 (from XP), to make the systems easier and cheaper to manage. He was also exploring options to use cloud computing to reduce management costs of running new servers. But, he expressed concerns about the pricing models (Thibodeau 2009).

IT played some interesting roles in the development of electric vehicles—such as the Chevy Volt for GM. Because EVs are such a big shift for consumers and manufacturers, new design issues arise that do not have years of data or prior solutions. GM's approach was to build multiple sensors into all of the early test vehicles. As employees drove the vehicles, the data was collected and reported to the designers. IT built new tools to retrieve and analyze the data. The designers used the data to evaluate tradeoffs and make decisions on the batteries, motors, and user interfaces (Brandon 2011). IT was also heavily involved in designing tools for monitoring battery and charging levels. Most EVs have the ability to report various status items to users through Web sites and smartphone applications.

Questions

1. How does GM's decentralized structure affect the implementation and use of ERP systems?
2. How does an integrated production and design system help GM design new cars?
3. Why is an integrated production system so important for building custom vehicles?

4. Will GM eventually be able to build a higher percentage of custom-ordered cars?

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Case: Chrysler-Fiat

In 1999, when former Chrysler CEO Bob Eaton introduced the redesigned Jeep Grand Cherokee, he held up a bag that he claimed contained all of the parts that were carried over from the earlier design. He seemed proud of this huge design change. But the costs had to be enormous. Toyota saves billions of dollars by reusing as many components as possible. Reuse also leads to more flexible production and design, enabling Toyota to produce new vehicles in a few months instead of

years (Taylor 2004). In 2007, Daimler spun-off the Chrysler Group by selling it to a private equity firm Cerberus. Daimler owned Chrysler for slightly under 10 years, and finally had to abandon it to restore profitability. In March, 1998 Daimler paid $36 billion for Chrysler and technically sold it for $7.4 billion, but the Wall Street Journal calculated that it would actually cost Daimler $650 million in cash to dump Chrysler. In the 2008 recession and liquidity crisis, Chrysler survived only through funding by the federal government. Eventually, the bulk of the company was sold to Fiat. The goal was to use Chrysler automotive technology (largely engines) to build larger cars in Europe and use Fiat's knowledge and production to build smaller cars for sale in the United States.

Technology in Manufacturing

In 2004, DaimlerChrysler had 104 manufacturing plants in 37 countries. Communication among the 362,000 employees was challenging across those distances. The company used videoconferencing and held more than 100 meetings a day with the technology, saving it as much as $14 million a year in travel expenses. The engineering teams used Web portals to share work and check on business information (Niccolai 2004).

In 1998, after the merger of Daimler and Chrylser, Susan Unger was named CIO and head of global IT operations of the new company. In the middle of the dot-com hype, she noted that she "had a different message, which was that in the 'e-world,' you have to have business value. It was kind of funny at the time because I was a voice in the wilderness talking that way." Because of this focus, the company worked on B2B initiatives. Unger notes that many other companies have had to write off their Internet projects, but "we have had none because we were kind of religious about ROI (return on investment" (Gibson 2004).

One of the big tools that DaimlerChrysler implemented was DELMIA from Dassault Systemes AG. Unger points out that as the engineer designs a vehicle, they can use the tool to create "a virtual manufacturing environment—including your work cells, your line, your equipment—and simulate your workers installing a wiring harness or whatever else." The multiple divisions (Daimler, Chrysler, and Mitsubishi) all use an e-engineering portal to share CAD information.

DaimlerChrysler was also a big user of the Covisint automotive auction system. Sue Unger noted that in 2003, the company used the system for almost 200 separate bids, saving it between 15 and 20 percent compared to traditional prices. More important, the system simplified the purchase process, reducing the time from months to days (Gibson 2004).

Auto Sales and the Internet

In the middle of the dot-com boom, some people were forecasting that all car sales would be made online within 6 to 10 years. Today, most sales are still made in person—partly because people want to see, touch, and drive the cars. Yet Sue Unger reports that 90 percent of buyers use the Internet for research before shopping (Gibson 2004).

Although DaimlerChrysler used incentives to try and gain market share for its primary models, Mitsubishi Motors was being hammered in the market. Their sales approach in 2002 did not help—when the company targeted first-time young buyers with a zero-zero-zero campaign. Essentially, even poorly qualified buyers could get new cars with nothing down and no payments for one year. Unfortunately, most of the cars had to be repossessed at the end of the year. In 2004,

Mitsubishi tried to recapture market share through marketing. This time with a new twist—a return to Internet advertising. In 2001, the company abandoned Web ads as nonproductive. In 2004, the company is spending $6 million on the Web alone. DaimlerChrysler increased its Web spending by 30 percent in 2003 (Mangalindan 2004). Although the Mitsubishi campaign represents only 5 percent of its total advertising, the company believes the Web ads are more effective than other approaches. The key: targeted ads and quick ties to dealers. Tom Buczkowski of Silver Creek, New York, is one who responded to the new approach. Researching SUVs at the Autobytel site, he was presented with an ad from Mitsubishi. By signing up for a test drive, he won a $15 gas card. At the Mitsubishi site, he built a customized Outlander. The details and the personal data he entered were sent to the nearest dealer in minutes. The next day, the dealer called him and suggested a test drive. Mr. Buczkowski was impressed with the response "If you get a response from somebody a day after the request, that's something you don't find too often anywhere else." He eventually bought a Mitsubishi.

Given the size of auto manufacturers and the number of dealers, providing communications with the dealers was a critical aspect to selling cars. DaimlerChrysler included 5,300 U.S. dealerships and another 1,500 worldwide. The manufacturer provided 240 applications to the dealers ranging from support and training to sales. Prior to 2003, most applications were standalone programs running with little or no control on dealer servers. Richard E. Earle, CIO at the Chrysler Group, led a group to replace all of the applications with Web applications running on a central server and accessible through Web browsers. With 300 to 500 internal developers working on the project, the DealerConnect system was built in a couple of years. Serving 300,000 users in 10 languages, it servers 8 million pages a day (Ulfelder 2005).

After the buyout by Fiat, Chrysler provided little financial and production information. The company focused on selling existing models until new, smaller cars could be designed by the Fiat team. In 2008, Chrysler IT did move more of its IT operations offshore to be handled by the Tata Consultancy Services (Thibodeau 2008).

In 2008, Chrysler tested an offer of a Wi-Fi hot spot as an option in its vehicles. The system would provide Wi-Fi connections within the car and use cellular phone service to connect to the Internet. At a base price of almost $500 plus $29 a month for service, it is not clear how many customers would purchase the option. Within a year, many smartphones began providing similar services—and they would not be tied to the car.

Questions

1. How do integrated design systems solve typical problems that arise?
2. Check out the Web sites by the automobile manufacturers. Why are they so bad? As a customer, what additional features would you want to see?

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Case: Toyota

Since the gas crises of the 1970s, Toyota has been gaining U.S. and world market share on American automobile manufacturers. Toyota had the lead in small-car design. Over time, the company leveraged this knowledge of consumer preferences to improve quality. The company was also the first to adopt lean manufacturing techniques to reduce costs and formal integrated quality control to take the lead in quality. Eventually, the company introduced the Lexus division to capture a large share of the high-end market. By 2007, the company was approaching the number-two position in sales. With common Japanese kerietsu ties to suppliers, Toyota pioneered just-in-time inventory deliveries. These inventory- and quality-control measures require considerable communication with suppliers. Toyota has adopted computer technology to facilitate communications. Toyota is trying to grow production capacity but with an emphasis on flexibility. Using its ties to suppliers and dealers, the company can increase or decrease production at any plant on short notice. It also tries to standardize vehicle platforms and keep the line flexible enough so that it can switch each line to a different product depending on the demand (2006 Annual Report and Duvall 2006). As with other manufacturers, Toyota uses advanced CAD systems to design new vehicles and parts. With this technology, Toyota has been able to reduce design time for a new vehicle from four years down to between one and two years. Toyota also centralizes all of its data. The CIO and executives have access to all global data when making decisions (Miller 2006). Toyota briefly took over the number two spot in U.S. sales, but its momentum was derailed when the tsunami hit Japan in 2011, causing disruptions in the supply chains for many components.

Technology in Sales

From 2000 on, the world auto industry had an excess production capacity, leading to intense competition; particularly in the United States. Online Web sites such as Edmunds and Vehix also made it easy for customers to search for cars and prices from multiple dealers. Profit margins at dealers fell for several years. To help maintain overall profits, dealers had to get bigger to increase volume and spread the overhead costs. Many also carry multiple brands of vehicles. Gulf States Toyota is a distributor for 145 Toyota dealers in five states. The company processes more than 190,000 vehicles a year at an 84-acre facility in Houston, TX. The company faced a problem in 2004 where they either needed to add more buildings or find a way to get vehicles through the facility more efficiently. WhereNet Corp provided an RFID-based vehicle tracking system. New vehicles delivered by rail car are tagged with an active RFID sensor and the VIN is entered into a database. The facility has 40 wireless LAN access points and 74 RFID readers. As vehicles enter and leave the facility, the data is picked up and entered into the database (Rosencrance 2005).

Toyota USA also needs to communicate with dealers and distributors. An early communication system developed in the early 1980s was based on IBM AS/400 technology. The system handled parts ordering and warranty claims, but all other communications needed to be handled by phone or fax. With 1,100 Toyota and Lexus dealers, Toyota needed a better way to communicate and improve dealer productivity. The Dealer Daily system was created to handle all common communications. It is a Web-based system running over a virtual private network (VPN) that links the dealers to Toyota headquarters. Dealers can order parts, file warranty claims, and manage financing and insurance for customers. Dealers pay for access to the system with a monthly fee based on the bandwidth they choose. Dealer Daily can also deliver critical news and information directly to any user at any dealership. Toyota is also working on a build-to-order system that will be integrated into Dealer Daily (Rosencrance 2002).

Led by the Prius, Toyota is one of the leaders in hybrid vehicles. In 2011, the company began expanding the role and variety of electric and hybrid vehicles—making Prius a separate division. Toyota also struck a deal with Salesforce.com to create a private social network for owners of its hybrid and electric vehicles. The Toyota Friend network will enable customers to share data with Toyota and other owners. It will provide notices for maintenance schedules and other issues. It will also allow customers to share driving and maintenance tips with each other—something that is commonly done now through a variety of public Web sites (Jennings 2011).

Toyota faced a couple of public image problems when it had to recall millions of vehicles in 2010. For many years, Toyota was perceived as a quality leader, and recalls and negative press affect that image. To take the next step at maintaining high quality, Toyota developed a business intelligence (BI) tool to monitor six years' worth of product quality data pulled from internal systems. The system consolidates and standardizes the data, enabling engineers to compare and filter data on configurations, customer call centers, warranty claims, and service centers. Tom Trisdale, manager of Toyota's Technical Information & Diagnostics Group noted that "The great thing is, everything is available from one source. We can have results very quickly" (Vijayan 2011). By using off-the-shelf software from Endeca, the IT department built the system within a few months. Similar to other BI projects, 45 percent of the time was spent on cleaning and standardizing the data to ensure consistency.

Questions

1. Why is information technology so important for lean just-in-time production?
2. Why does Toyota use online searches for vehicles in stock instead of building cars to order?
3. Given the sophistication of Toyota's systems, why have defect rates and design problems increased?

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Summary Industry Questions

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