OUTLINE

OPENING CASE

NG: USING CAD TO DESIGN A NEW AIRPLANE

Boeing began designing its new 777 airliner by spending a year working with eight airlines to obtain consensus about design issues such as the width of the fuselage, the shape of the overhead compartments, and the use of folding wingtips so that a larger plane would fit into existing airport gates. To complete this work, Boeing had to design 130,000 unique parts. By including rivets and fasteners Boeing engineers could say that the airplane they were producing would be "3 million parts flying in very close formation." The traditional approach to designing an airplane was to produce drawings for each part and assembly, manually check the drawings for compatibility and placement, build a scale model, and discover and fix the mismatches. Boeing decided to move to a paperless design process using CATIA, a mainframe-based computer-aided design (CAD) tool originally developed by the French aircraft manufacturer Dassault.

The basis of the new paperless design process was a CAD specification of the precise shape and location of every component. CATIA could use data to generate realistic pictures of individual components or combinations of adjacent components. Creating these specifications and making sure they were compatible was the principal work product of 238 engineering teams of up to 40 engineers. The data storage capacity for the system was 3.5 terabytes (trillion bytes), and the data was made available to 7,000 workstations spread around the world. Online access to the database of CAD specifications permitted an engineer working on any part to access the specifications, and hence electronic drawings, of any related part. Traditional delays in finding, copying, and moving paper drawings were eliminated.

Having all of the design data in an electronic database made it possible to test automatically for mutual interference between components. An electronic preassembly program called CLASH displayed flashing red zones whenever two separate components were designated to be in the same location, such as when one engineering team planned

to run an electric cable through a location reserved for ductwork by another team. To test whether maintenance technicians could actually reach every location that required maintenance the CAD team created simulated human forms that could be put into any location in the position needed to do the work. Physical mock-ups were constructed for some aircraft subsystems, but the CLASH program was so effective at detecting interference between parts that further mock-ups were not used. The complete CAD specifications were fed into computer-controlled fabrication equipment, whose error rate in a fuselage 20-33 feet in diameter was less than one part in 10,000.[1, 2]

WEB CHECK ✓

IBM's Web site cites CATIA as an IBM e-business solution for "product life cycle management and engineering."[3] Use a search engine to find an introduction to the latest version of CATIA and identify its main features and benefits.

DEBATE TOPIC

There is a trend toward using CAD and linking it to computer-controlled fabrication equipment. Is this a major threat to the job security of both product designers and factory workers?

The Boeing CAD case starts this chapter because it illustrates facets of the different types of information systems that this chapter will discuss:

Office automation systems: CAD is basically a tool for recording and manipulating information. In some ways it is like a word processor and spreadsheet for design engineers.

Communication systems: Effective communication and collaboration between thousands of engineers at locations around the world was essential for the success of the project.

Transaction processing systems: Each time an engineer changed the design, the new information had to be validated, stored in a database, and made available for subsequent retrieval. This reflects the spirit of transaction processing systems used in retail and wholesale businesses to enter orders and record shipments.

Management information systems and executive information systems: Although not mentioned in the case, Boeing management needed information to plan and manage the project. This involves information systems directed at managers and executives.

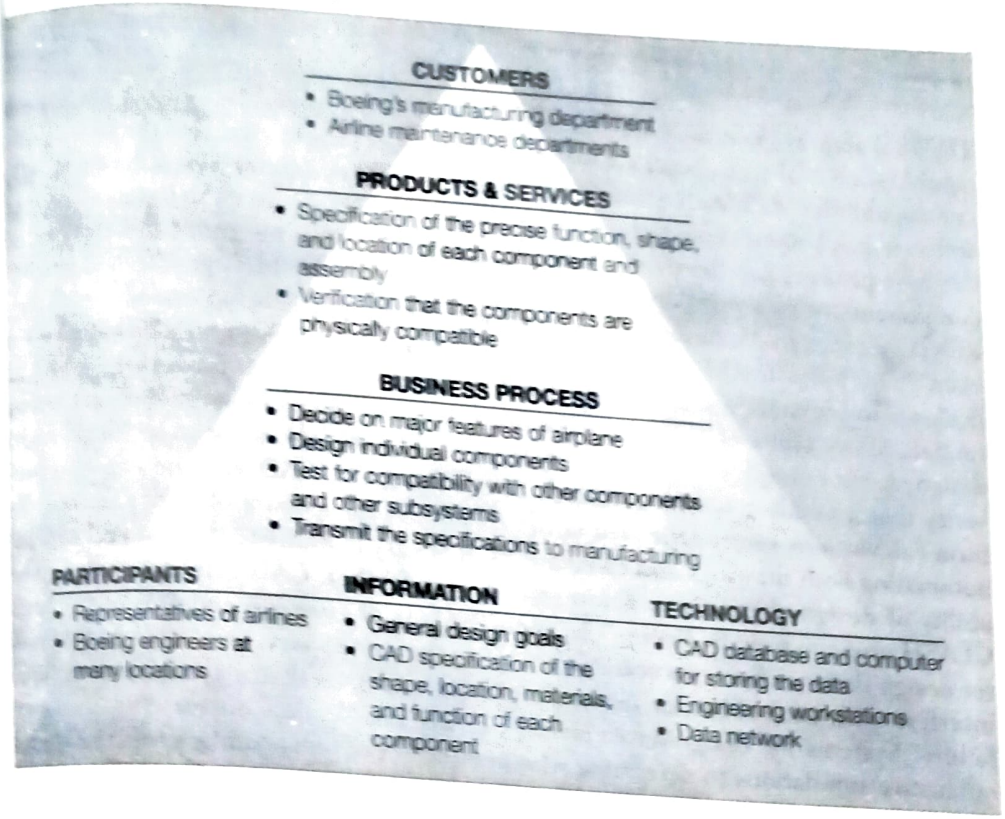
Decision support systems: During the course of the design work the software provided various types of guidance, including identifying mutual interference between components.

Enterprise systems: The term "enterprise system" typically focuses on creating an enterprise-wide infrastructure of transaction data, but the spirit of Boeing's coordinated design effort requires a somewhat similar use of databases and communication capabilities that keep a large, geographically dispersed enterprise operating together.

The previous chapters introduced the value chain, explained how to think about work systems and information systems in a particular situation, and introduced many ideas related to business processes, information, and databases. This chapter shows the range of possibilities for using information systems to improve communication, decision-making, and entire business processes within organizations.

The first part of the chapter looks at some of the information systems often associated with specific functional areas. Such systems include CAD, MRP, SCM, CIM, CRM, and others. The second part of the chapter describes the different idealized types of information systems that might be used in any functional area of business. These systems include OAS, communication systems, TPS, MIS, DSS, and enterprise systems.

WORK SYSTEM SNAPSHOT
Using CAD to design the Boeing 777



Although it is important to recognize commonly used vocabulary of the IS field, you will see that the names of different types of information systems have changed over the years as innovators invented new methods and combined old ones into new forms. One result is that system classifications are always in flux. People name and describe a new type of system, such as a decision support system or executive information system. Ten years later, the name still exists but some of the original characteristics are no longer as important or have become commonplace. Eventually many information systems contain characteristics from several system categories. Furthermore, any particular information system that might fit a particular category today might not fit tomorrow when additional features are added.

Many real-world systems like the Boeing design system incorporate aspects of different types of information systems. This means that information system categories are less useful as rigid classifications and more useful as aids in identifying possible directions for improvement in any particular situation. Understanding the categories helps in visualizing the potential applicability of different approaches for applying IT and in recognizing strengths and weaknesses of those approaches.

INFORMATION SYSTEM CATEGORIES RELATED TO SPECIFIC FUNCTIONAL AREAS OF BUSINESS

Chapter 1 identified typical business processes in different functional areas of business (refer back to Figure 1.3). It also explained the supply chain, internal value chain, and customer experience (refer back to Figure 1.5). E-business applications have improved, and in some cases revolutionized the way these functional areas operate in many companies. This section looks at some of the important innovations in information systems and commercial software that are directly related to product design, supply chain, manufacturing, sales and marketing, and finance. Although most of these e-business innovations were underway before commercial Internet applications began in the early

1990s, the Internet has provided many new ways to extend and improve methods that were already in use. The second part of the chapter will look at the different types of information systems that might be used anywhere in the value chain.

Product Design Systems

The first step in creating value for the customer is designing the product based on a combination of the customer's desires, the designer's imagination, and the firm's goals and capabilities. As was illustrated by the Boeing case, **computer-aided design** (CAD) software has helped change the nature of design processes once the basic concept of the new product has been envisioned. CAD software accepts coded descriptions of components or processes and can display the resulting product specification graphically. CAD starts with the ability to draw the shape of an object but extends much further. It includes the ability to create photo-realistic representations that allow a designer to see exactly what an object will look like without ever producing a physical model. Many types of CAD also include the ability to evaluate the object being designed. For example, an electrical engineer might test a circuit, or an architect might verify that a building is strong enough before it is built. CAD software can also perform calculations such as the area of the rooms and the amount of paint required. By automating both drawings and calculations, it is easy to evaluate the cost and acceptability of design alternatives. Taking this a step further, CAD software such as the CLASH program used by Boeing can apply the laws of geometry and physics to check for design flaws such as two objects occupying the same space, moving parts that will interfere with each other, or excessive physical stresses that may cause structural failure. Systems for designing electrical circuits and semiconductor chips can run exhaustive simulations to determine whether correct outputs will be produced under all foreseeable conditions.

A surprising aspect of CAD is its wide range of applications. When CAD was originally conceived, it was a tool comparable to a word processor for engineering drawings. CAD has moved out of the engineer's domain and has become an integral tool in organizational processes for creating and testing products and product modifications. The visualization capabilities in advanced CAD systems permit the customer to have a simulated walk-through of a building that has never been built or to view how a washing machine works even though it has not yet been manufactured. This is the type of capability that Boeing used to design the Boeing 777 airliner without ever creating a physical scale model. Although most CAD applications are used for electronic, mechanical, and architectural design, CAD has also moved into a broad range of activities that use two- or three-dimensional representations. Orthopedic surgeons and plastic surgeons use CAD to design operations; clothes designers use CAD to design clothes; even hairdressers can use a form of CAD to try out alternative hairstyles before they cut hair (see **Figure 5.1**).

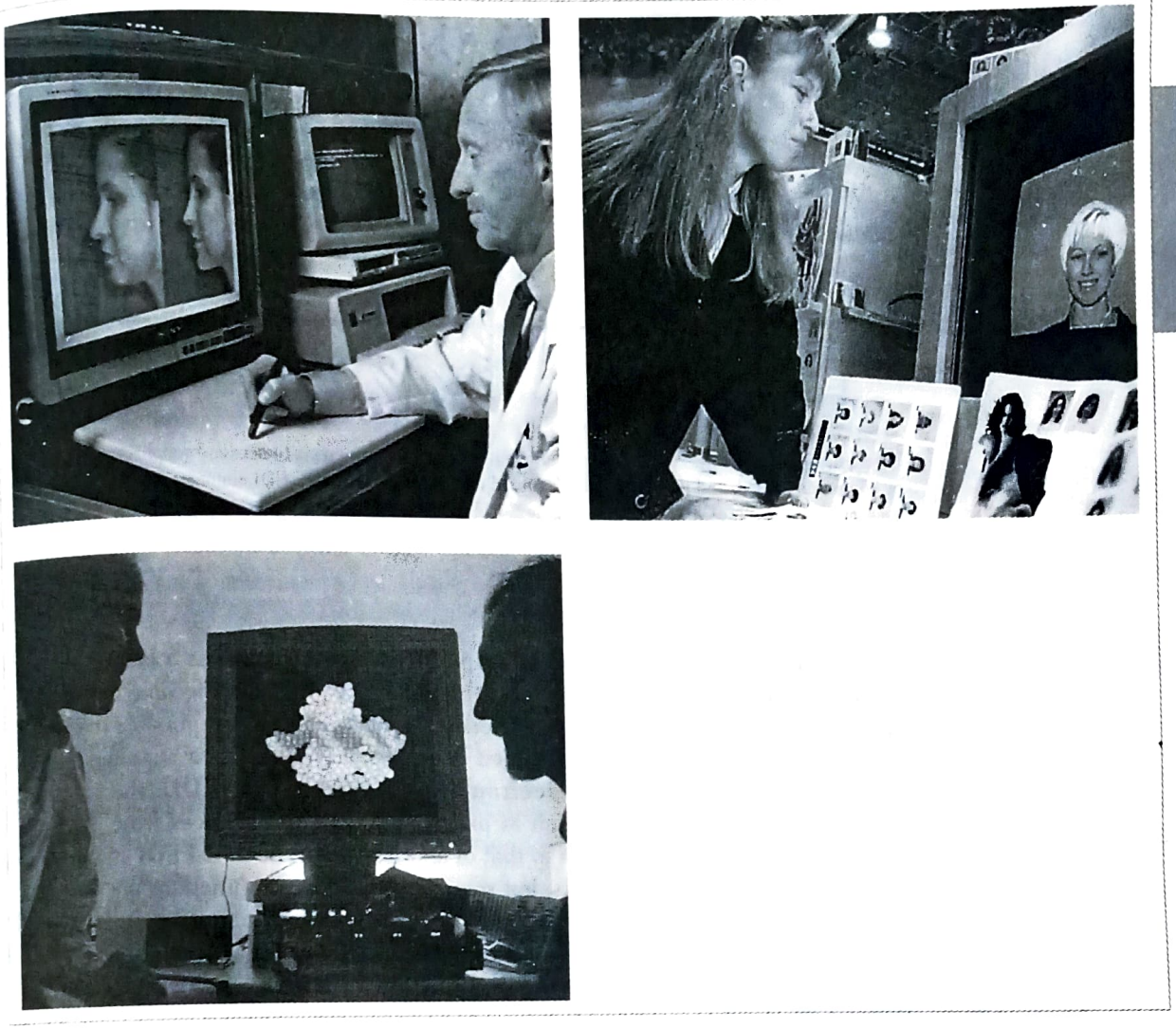
Supply Chain Systems

Chapter 1 introduced the concept of the supply chain, the transactions, coordination, and movement of goods between suppliers and the firm. Regardless of whether the firm is a manufacturer or a retailer, its supply chain for raw materials and components should assure reliable, low-cost acquisition of whatever it needs. For a manufacturer, all necessary materials should arrive just before the manufacturing schedule calls for its use. If it arrives too late, manufacturing will be disrupted. If it arrives too early, money and warehouse space will be tied up in unused inventory for too long, and the material may even become obsolete if the product changes. The challenge is similar for retailers. If the merchandise arrives too early it will tie up money while it sits on shelves or racks. If it arrives too late the customer will have already gone somewhere else and it may be necessary to sell the merchandise at deep discounts before the next product season.

Supply chain systems start with information about what inventory is available, when previously ordered material will arrive, and when material will probably be needed based on manufacturing schedules or sales forecasts. This information is used to:

FIGURE 5.1

CAD in unexpected places

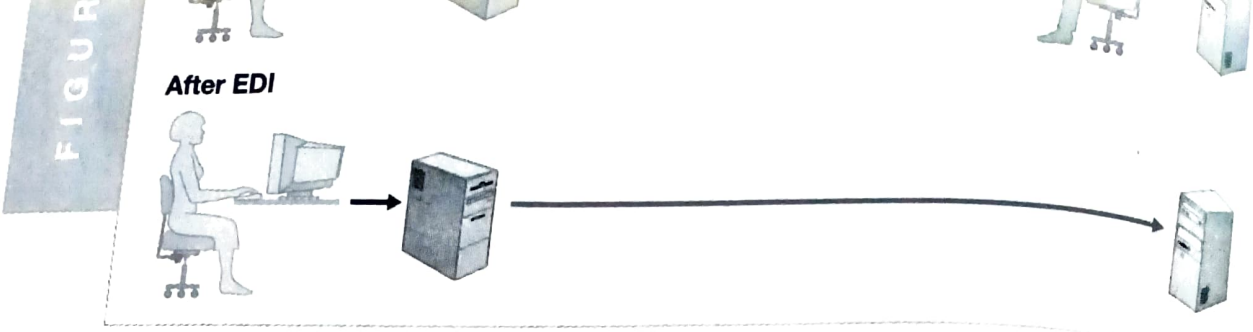


CAD has been used for a wide range of applications, some of which might seem surprising.

- Determine material requirements for future weeks or months
- Generate new orders
- Send the orders to suppliers
- Obtain commitment dates for likely receipt
- Verify that the ordered material actually arrived

Delays between these steps reduce procurement efficiency. The slower the system operates, the more likely it is that demand will change before the material arrives. If demand increases, the material will be insufficient and customers will be inconvenienced or will go elsewhere. If demand decreases, the excess material will tie up money and may become obsolete before it is ever used.

The first commercial software packages that addressed major parts of the supply chain were called **material requirement planning** (**MRP**) systems. These systems attempted to integrate purchasing and production activities. MRP systems start with a firm's output requirement by week or other period and work backward to calculate a schedule of how many units of the finished product and intermediate products must be started, when the units must be started, and when the necessary materials must be ordered. They also permit user adjustments in case lead times are inadequate or in case capacity is insufficient.



Before EDI, purchase orders and many other communications between customers and suppliers were generated by computer, mailed, and then manually reentered into another computer. EDI eliminates delays and increases accuracy by providing electronic transmission of data between the customer's computer and the supplier's computer. Web-based versions of EDI reduce costs even further by using widely available, non-proprietary infrastructure.

Initially, data processing related to purchasing was viewed as a largely internal process of ordering the right material at the right time. This view became outdated for many large distributors and manufacturers when networks made it possible to transmit data between companies. Links between large companies and their suppliers became more effective with the use of **electronic data interchange (EDI)**, the electronic transmission of business data such as purchase orders and invoices from one firm's computerized information system to that of another firm. The initial EDI systems used proprietary software and networks, but some of the same EDI functions are now available at lower cost through the Web. Since electronic data transmission is virtually instantaneous, the supplier's information system can check for availability and respond quickly with a confirmation. Figure 5.2 illustrates some of the advantages of EDI. Before EDI, the data from one computerized system was printed on paper, mailed, and reentered into another computer. In terms of dollars, a company typically spent $55 to process a paper purchase order, whereas EDI could reduce that amount to $2.50,[4] and Web-based versions of EDI can cut the cost even further.

The more current idea of **supply chain management (SCM)** goes beyond automating data transfers. It is the overall system of coordinating closely with suppliers so that both the firm and its suppliers reap the benefits of smaller inventories, smoother production, and less waste. Standardizing and automating both internal data processing and data transfer between suppliers and their customers is fundamental for SCM because this makes procurement systems faster and more effective.

SCM system and EDI (whether Web-based or not) are essential ingredients in a trend toward integration between suppliers and their customers. The more integrated they are, the quicker suppliers respond to customer requests and the quicker customers respond to schedule changes at the supplier. This trend toward integration applies if the supplier and customer are separate firms or if they are departments within a single firm. This tighter integration across several consecutive stages of a product's value chain was possible a decade ago, as illustrated by the links between Dillard's Department Stores, the apparel manufacturer Haggar, and the textile manufacturer Burlington Industries. When Dillard's inventory of a pants style went below a specified level, it automatically sent an electronic message to Haggar. In turn, Haggar electronically notified Burlington Industries if it didn't have enough cloth to manufacture the pants Dillard's requested.[5]

Manufacturing Systems

A manufacturing system is a firm's system of producing physical (or informational) products that it sells. The impact of IT on manufacturing systems came in several waves. The first uses were in keeping track of inventory and work-in-process and in performing record keeping about who did what work, when they did it, and how well they did it. Separate manual record keeping has gradually been replaced by the use of bar codes and automatic sensors. In addition, computerized controls have been built into the manufacturing equipment itself. The most highly automated factories operate under conditions that once seemed like science fiction. For example, as early as 1983 a Fanuc factory in Japan producing 10,000 electric motors a month operated with people doing maintenance during the day and only robots working at night. The factory contained 60 machining cells and 101 robots and produced 900 types and sizes of motor parts in lots ranging from 20 to 1,000.[6] Automated machinery actually is only one type of component of an automated factory. In totally automated factories, all production is scheduled and performed automatically. This requires extensive information systems that integrate automatic material movement, automatic scheduling of all work steps, automatic execution of work steps, and automatic sensing of quality.

Despite progress in automating manufacturing systems, most current factories are only partially automated because it is possible to get better results by automating some functions and leaving others to the flexibility, common sense, and ingenuity of human workers. The success of the only partly automated NUMMI joint venture between General Motors and Toyota is a case in point (mentioned in Chapter 3).

Even when the major work steps are only partially automated, IT has often had a major impact in manufacturing through various degrees of computer-integrated manufacturing (CIM), which includes computerized data collection and integrated data flows between design, manufacturing, planning, accounting, and other business functions. When people in one department complete their tasks, the data produced are immediately available for use by people in other departments. Technical advances in the last decade that have made CIM more of a reality include increased computer power at much lower cost, better data management capabilities, and distributed computing and telecommunications. Reasons for adopting CIM include reduced cost, better quality, better customer service, greater flexibility in responding to customer requirements, and quicker time-to-market with new products.

The use of CAD, CIM, and other computer-based techniques is gradually changing the logic of manufacturing. It is increasingly divided between two computerized phases. First is a design phase, which creates a computerized description of the product including the options that customers can select. Next is a manufacturing phase, which uses the computerized description directly. As manufacturing moves in this direction, there is an increase in the **information content of products**, the degree to which the value of products resides in product specification information rather than in just physical objects.

Heightened customer expectations have made more extensive customization a key competitive issue for many products. The ability to link CAD systems to order entry systems and to transmit order details directly into the factory is making it more practical to tailor anything from clothes to machines based on the customer's requirements or wishes. Today many firms are moving toward **mass customization**, the use of mass production techniques to produce customized products or services. Mass customization is an attempt to retain the advantages of mass production while providing value related to customization. From the manufacturer's viewpoint, the product or service is mass-produced. From the consumer's viewpoint, the product or service is customized. Figure 5.3 shows an example of mass customization. Matsushita's National Bicycle increased its share of the Japanese sports bicycle market from 5% to 29% by moving from inexpensive, noncustomized bicycles to customized bicycles that start from measurements determining the exact size of frame the rider needs.[7]

A subsidiary of Matsushita uses an information system to build customized bicycles in Japan. The photo on the left shows the session in which the customized dimensions of the bicycle are determined. These measurements are entered into a special computer-aided design (CAD) system that creates a diagram (shown on right) that is transmitted directly to the factory.

Sales and Marketing Systems

The previous sections on product design and manufacturing show how IT makes it easier to provide the product the customer wants, when and where the customer wants it. IT also enables companies to use radically different sales and marketing approaches than were possible when IT applications were less developed. E-commerce is but one of the newer approaches, and a number of e-commerce business models were mentioned in Table 1.2.

Even without electronic links to customers, IT has had a major impact on traditional sales activities such as keeping track of customers or taking orders. One of the most important innovations in keeping track of customers occurred as a by-product of **point-of-sale (POS)** systems that use bar codes to generate customer bills at checkout counters. Many supermarkets now give their repeat customers an ID card for check cashing and for rewarding customer loyalty with discounts on selected items. Using the ID cards in conjunction with POS systems provides the extra benefit to the store, namely, a cumulative history of every item the repeat customer purchased on each trip to the store.

Combining POS data with other data related to magazine subscriptions, personal affiliations, and Web usage can lead to valuable and sometimes controversial indications of preferences and buying patterns linked to individuals. These are the basis of **direct marketing**, the process of selling through communications addressed to specific individuals who are likely to be interested in the product. Direct marketing is based on **addressability**, the ability to direct specific messages to specific individuals via paper mail, telephone, or e-mail. Direct marketing tries to improve upon newspaper advertising, broadcast advertising, and mass mailings that often have a low yield rate because most of the people who see the message are not interested.

Combining customization techniques with addressability creates possibilities of directing different messages to different customers. This has been used for years in the world of print journalism. For example, *American Baby* adapts the mix of editorial and advertising pages to the age of the baby in each subscriber's household. It does this through a process called selective binding, in which different pages are included in a magazine depending on subscriber characteristics stored in a subscriber database. Even 10 years ago, *Farm Journal* recognized 5,000 different subclassifications of farm type and geographic region and produced a different edition

for each.[8] Small companies can also use direct marketing techniques based on addressability. Some small clothes retailers maintain a customer list and record the color and size of each item sold to each customer. This enables them to send out pre-Christmas mailings to their customers' spouses mentioning Christmas gifts that might go well with "the tan slacks Pat purchased last month." Since Web servers can keep track of every access from a particular computer and since Web pages are transmitted in an electronically coded form, it is possible to create a similar degree of personalization by customizing Web pages for a particular user based on that user's past visits to the site.

Direct marketing using a telephone is called **telemarketing**. Although it requires nothing more than a telephone and a list of telephone numbers, important aspects of telemarketing can be automated. Having the telephone numbers on a computer makes it possible to dial phone numbers automatically, and even redial automatically if the line is busy. Once the telephone connection is established, the computer can display a script outlining the main points to be covered in the call. The script can even move into different branches depending on responses entered into the computer by the telemarketing agent. If any follow-up action is required, the system can record that data in the database for later use. If a product or service is sold, the sales transaction can be processed immediately. Any data gathered during the phone call can remain in the database to improve the targeting of future telemarketing efforts toward this account. For example a stockbroker might learn that a potential client will have funds to invest at a future time and is interested in long-term bonds.

Sales work has also been facilitated through sales force automation systems and customer relationship management systems. As with many information system categories, SFA and CRM overlap substantially because the popular name gradually changed from SFA to CRM. **Sales force automation (SFA)** traditionally focused on data handling and data retrieval tasks related to personal scheduling, opportunity tracking, contact management, note and information sharing, tracking the progress of sales cycles, and providing revenue forecasts to headquarters as an input to financial planning. Contrary to the name, most commercial SFA packages do not actually automate sales work. A common problem with SFA packages is that they require salespeople to do a lot of data entry work. Many salespeople resent this because a major part of their efforts devoted to SFA mostly support headquarters rather than their own attempts to earn commissions.

Customer relationship management (CRM) addresses the somewhat broader topic of planning, controlling, and scheduling pre-sales and post-sales activities. These include everything in SFA, but also recognize that from a firm's viewpoint, the relationship with a customer starts with the sales cycle and continues through customer service activities, product maintenance, and repeat sales. An important part of CRM is the collection of data from customer interactions such as service calls, call center responses, sales transactions, and Web-site activity. Analyzing these types of customer relationship data potentially helps in identifying patterns that are useful in crafting marketing campaigns and building targeted sales pitches. It also potentially helps in figuring out how to serve different groups of customers more effectively and profitably.

Another important sales application sometimes linked with SFA and CRM is the ability to generate a correctly priced sales proposal on the spot without delays for getting back to headquarters. This is a traditional problem of salespeople who travel to customer sites to sell products ranging from perishable farm produce to life insurance to heavy equipment. In each case, the sales process is undermined by any inability to respond immediately to questions about product availability or final prices after discounts are applied. Cellular phones, e-mail, voice mail, and even networked database access all make it easier to get messages from an office without interrupting anyone else. Data and models on laptop computers or accessible through the Web make it easier to demonstrate options and to provide accurate pricing information because the same rules that might be used at the office can be programmed into the laptop.

nance Systems

The field of finance includes the business of finance as well as the finance depart-ments within all firms, regardless of what those firms produce. Firms in the business of finance include banks, credit card companies, stock brokerages, home mortgage companies, currency traders, and suppliers of financial information. The "products" in the business of finance include bank accounts, money market funds, credit cards, loans, and buying and selling of stocks, bonds, foreign currencies, real estate, and even entire businesses. The finance function within a typical business is a support activity that handles transactions involving money, produces financial statements, and pays taxes. These are all essentially information system functions, and they have been computerized for decades. The difference in the 1990s, however, is that this information has been integrated more effectively and made more readily available for decision-making in matters ranging from how to treat slow-paying customers to how to invest the firm's working capital so that it generates revenue even when it is not being used immediately.

To better understand the impact of IT on finance systems, consider the changing form and use of money, which was first invented because people found that bartering for everything was inconvenient. Using money made it possible to exchange value without possessing the specific commodity the trading partner wanted. Money had its own problems, however. What if you wanted to buy something but didn't have your cash at hand? Or what if you wanted to pay a bill without traveling to the merchant's place of business and handing over cash? Or what if you simply didn't want to carry large amounts of cash? Information systems are the basis of a number of alternatives that were developed or are still being developed:

- *Checking accounts* are basically information systems that keep track of account balances and permit people to write checks if they have enough money in their bank accounts. But checking accounts operate using paper checks that take days to clear though a complex settlement process.
- *Credit cards* permit users to make payments through short-term loans. Credit cards require large-scale information systems for approving transactions quickly, consolidating monthly customer statements, and paying merchants.
- *Debit cards* are based on a similar idea, but operate differently. Instead of providing credit to be paid off later, debit cards move money immediately from the cardholder's account to the merchant's account.
- *Smart cards*, such as prepaid phone cards, copy cards, and electronic meal tickets, provide another card-based option in which a person transfers an amount such as $10 or $20 onto a card containing a memory chip. The **smart card** is used via simple vending machines that deduct the amount of a purchase from the stored amount on the card and add that amount to an account that is receiving the payment.
- *Electronic cash* is currently being promoted in several forms as a way to make small payments for access to information on the World Wide Web or for other small transactions for which credit card systems are prohibitively expensive. The basic idea is similar to that of a smart card except that the record keeping takes place on a PC instead of a smart card. A person acquires the **electronic cash** by transferring funds to a company that issues electronic cash by updating information on the purchaser's personal computer. When the electronic cash user makes a purchase, the electronic balance on the computer is reduced by the purchase price and the merchant's account on a different computer is increased by the same amount.

Electronic cash is actually a newer, limited version of electronic funds transfer (EFT) that has been used for several decades. EFT uses electronic messages to settle accounts between banks and other businesses. Use of EFT is more efficient than transferring physical money because it only requires transmission of suitably encrypted electronic messages.

Information systems are also essential for the operation of stock and commodity markets. These markets simply could not operate at their current scale without computerized systems for entering buy and sell orders, transmitting them to the traders, recording the transactions, and making payment within three days. This reliance on computerized systems became highly visible during the stock market crash on October 19, 1987, when over 500,000,000 shares were traded on the New York Stock Exchange. This was more than twice the previous high volume. Because of this unprecedented data processing load, the online information about stock prices lagged as much as two hours behind the trading on the floor of the stock market, contributing to the panic during the crash. Subsequent IT investments increased capacity to well over a billion shares per day.

Real-time (immediate) access to the latest stock, bond, and commodity price information has also permitted large firms to automate certain buy and sell decisions using a technique called **program trading**. An approach to program trading that exploits the availability of real-time information is using the speed of computers to search for temporary discrepancies between current prices of large groups of stocks and options to buy or sell these stocks in the future. Upon finding such discrepancies, the system can lock in a guaranteed profit by buying stocks in one market and selling options in the other. A fundamentally different approach to program trading uses statistical analysis and models to identify price conditions under which specific buy or sell orders have a high probability of making money. Some observers believe this form of program trading tends to reinforce instability when market values are changing rapidly. In response, the New York Stock Exchange has created rules called "circuit breakers," which disallow program trading if aggregate price indicators, such as the Dow Jones Industrial Average, have changed more than a particular amount in any day.

Even individual investors with small portfolios are benefiting from current finance systems. As was explained in the Charles Schwab case in Chapter 3, the first online brokerage services for consumers became available in the mid-1980s and the first Web-based brokerage services appeared in 1996. By the year 2000, millions of individuals had online brokerage accounts and could place trades with far lower brokerage commissions than had been the norm just five years earlier.

The preceding examples of functional area systems across the value chain barely scratch the surface, but they illustrate that e-business approaches have been with us for several decades and show that IT is playing an increasingly important role in the way business is conducted.

REALITY CHECK ✓

E-Business Applications in Every Business Function

This section mentioned several e-business applications in a number of business functions.

1. Give examples of how some of these IT-based innovations have affected you directly.
2. Identify other IT-based innovations that have affected one or more business functions in important ways.

INFORMATION SYSTEM CATEGORIES THAT APPLY IN ANY FUNCTIONAL AREA OF BUSINESS

1, 2, 3, 4, 5, 6, 8,

The previous sections focused on types of information systems associated with specific functional areas of business. The remainder of this chapter looks at six types of information systems that apply in any functional area.

Any discussion of types of information systems faces a difficult problem because the categories simply won't hold still. The first computerized systems were used to collect and summarize data about financial transactions or work that had been done in the

past. The advent of real-time computing made it possible to integrate computers the process of doing the work itself. The advent of personal computers made it po to provide personal tools individuals could use to keep track of their own inform independent of what the rest of the organization was doing. Moreover, the vast sion of communication capabilities and computer networks made new types of oriented systems possible.

Perhaps more problematic from a purist's viewpoint, the categories are not ally exclusive. Information system categories differ in this regard from categories in the natural sciences, where there is often detailed agreement about small differ between biological species or chemical compounds. In contrast, information s categories often overlap and change as new applications combine new capabilities old ones.

Despite this classification problem, general categories must be discussed bec the terms are used frequently in business and because each category supports munication and decision-making from a different and important viewpoint. Tabl summarizes the basic idea of each type of information system along with the w each type supports communication and decision-making. Table 5.2 gives a brief ex ple of each in the functional areas of sales, manufacturing, and finance. After in ducing each system type, the chapter concludes with general issues related to all system types.

OFFICE AUTOMATION SYSTEMS

An **office automation system** (OAS) facilitates everyday information processing tas in offices and business organizations. These systems use a wide range of tools suc as spreadsheets, word processors, and presentation packages. Although telephones e-mail, v-mail, and fax can be included in this category, we will treat communicatio systems as a separate category.

OASs help people perform personal record keeping, writing, and calculatio chores efficiently. Of all the system types, OASs and communication systems are the most familiar to students. Tools generally grouped within the OASs category include:

Spreadsheet programs, which provide efficient methods for performing calculations that can be visualized in terms of the cells of a spreadsheet. The first spreadshee program was VisiCalc, which helped create the demand for the first personal com puters in the late 1970s.

Text and image processing systems, which store, revise, and print documents con taining text or image data. These systems started with simple word processors bu have evolved to include desktop publishing systems for creating complex docu ments ranging from brochures to books.

Presentation packages, which help managers develop presentations independenth instead of working with typists and technical artists. These products automatically convert outlines into presentation pages containing appropriately spaced titles and subtitles.

Personal database systems and *note-taking systems*, which help people keep track of their own personal data (rather than the organization's shared data). Typical appli cations include an appointment book and calendar, a to-do list, and a notepad.

When using these tools for personal productivity purposes, users can take any approach they want because the work is unstructured. Some individuals use these tools extensively and enjoy major efficiency benefits, whereas others do not use them at all. The same tools can also be used for broader purposes, however, in which they are incorporated into larger systems that structure and routinize tasks in organizations. For example, a corporate planning system may require each department manager to fill in and forward a preformatted spreadsheet whose uniformity will facilitate the corpora tion's planning process.

TABLE 5.1

Typical Ways Each Type of Information System Supports Communication and Decision-Making

Although people often think of information systems as tools for decision-making, each type of information system supports both communication and decision-making in a number of ways

System type	Typical user	Impact on communication	Impact on decision-making
Office automation system: provides individuals effective ways to process personal and organizational business data, to perform calculations, and to create documents	• Anyone who stores personal data, creates documents, or performs calculations	• Provides tools for creating documents and presentations, such as word processors and presentation systems	• Provides spreadsheets and other tools for analyzing information • Communication tools also help in implementing decisions
Communication system: helps people work together by interacting and sharing information in many different forms	• Anyone who communicates with others, including office workers, managers, and other professionals	• Telephones and video conferencing for communication • E-mail, v-mail, fax, for communication using messages and documents • Access to memos and other shared information • Scheduling meetings • Organizing and expediting interactions during meetings • Controlling flow of work	• Telephones and teleconferencing for decision-making • E-mail, v-mail, fax, other tools for obtaining information • Support sharing information related to making joint decisions
Transaction processing system (TPS): collects and stores information about transactions; controls some aspects of transactions	• People whose work involves performing transactions	• Creates a database that can be accessed directly, thereby making some person-to-person communication unnecessary	• Gives immediate feedback on decisions made while processing transactions • Provides information for planning and management decisions
Management information system (MIS) and executive information system (EIS): converts TPS data into information for monitoring performance and managing an organization; provides executives information in a readily accessible interactive format	• Managers, executives, and people who receive feedback about their work	• Provides a basis of facts rather than opinions for explaining problems and their solutions • May combine e-mail and other communication methods with presentation of computerized data	• Provides summary information and measures of performance for monitoring results • May provide easy ways to analyze the types of information provided in less flexible form by older MIS
Decision support system (DSS): helps people make decisions by providing information, models, or analysis tools	• Analysts, managers, and other professionals	• Analysis using DSS helps provide a clear rationale for explaining a decision	• Provides tools for analyzing data and building models • Analysis using a DSS helps define and evaluate alternatives
Enterprise system: creates and maintains consistent data processing methods and an integrated database across multiple business functions	• People who enter transaction information • Managers and executives • Anyone who needs transaction information from other business functions	• Maintains a database that can be accessed directly, thereby making some person-to-person communication unnecessary • Establishes and maintains uniformity that makes communication easier	• Maintains a database that provides uniform, consistent information for decision-making • Establishes and maintains uniformity that makes it easier to use information while making decisions

5.2

TABLE

Examples of Each Type of Information System in Three Functional Areas of Business

One of the reasons the various categories are mentioned frequently is that each is used in every functional area of business

System type	Sales examples	Manufacturing examples	Finance examples
Office automation system	• Spreadsheet to analyze different possible prices • Word processor to create sales contract	• Spreadsheet to analyze a production schedule • Word processor to write a memo about how to fix a machine	• Spreadsheet to compare several loan arrangements • Word processor to write a memo about new financial procedures
Communication system	• E-mail and fax used to contact customer • Video conference to present new sales materials to sales force • Workflow system to make sure all sales steps are completed • System to coordinate all work on a complex sales contract	• E-mail and v-mail used to discuss a problem with a new machine • Video conference to coordinate manufacturing and sales efforts • Workflow system to make sure engineering changes are approved	• V-mail and fax to communicate with bank about loan arrangements • Video conference to explain effect of financing on factory investments • Workflow system to make sure invoice approval precedes payment • System for exchanging the latest information related to a lawsuit
Transaction processing system (TPS)	• Point of sale system for sales transactions • Keeping track of customer contacts during a sales cycle	• Tracking movement of work-in-process in a factory • Tracking receipts of materials from suppliers	• Processing credit card payments • Payment of stock dividends and bond interest
Management information system (MIS) and executive information system (EIS)	• Weekly sales report by product and region • Consolidation of sales projections by product and region • Flexible access to sales data by product and region	• Weekly production report by product and operation • Determination of planned purchases based on a production schedule • Flexible access to production data by product and operation	• Receivables report showing invoices and payments • Monthly financial plan consolidation • Flexible access to corporate financial plan by line item
Decision support system (DSS)	• Model helping insurance salespeople test alternatives • Marketing data and models to analyze sales	• Model determining current priorities for machine operator • Production data and models to analyze production results	• Analysis of characteristics of customers who pay bills promptly • Stock database and models to help in selecting stocks to buy or sell
Enterprise system	• Help a sales rep enter an order and establish that enough capacity exists to meet the schedule	• Help the manufacturing manager to schedule maintenance based on minimizing disruption to sales	• Help the finance department track the cost of production back to purchase orders

COMMUNICATION SYSTEMS

Electronic **communication systems** help people work together by exchanging or sharing information in many different forms. New communication capabilities have changed the way many businesses operate by making it possible to do many things at a distance that previously required being present in a specific location. This section covers a wide range of these tools. Teleconferencing systems make it possible to hold same-time, different-place meetings. A variety of technologies including e-mail, voice-mail, fax, instant messaging, and chat rooms make it possible to transmit specific messages to specific individuals or groups of individuals. Groupware systems start with messaging but go further by facilitating access to documents and controlling team-related workflow. Intranets and extranets extend the scope of groupware by using Web

technology to provide dispersed groups of employees, suppliers, and customers ready access to information ranging from employee manuals and product catalogs through news bulletins and schedules. Knowledge management systems often use intranets to facilitate the sharing of knowledge, not just information. Group support systems help facilitate meetings.

Teleconferencing

The use of electronic transmission to permit same-time, different-place meetings is called **teleconferencing.** We can think of a traditional telephone call as a minimal teleconference, but the term normally is applied to other options including audio conferencing, audiographic conferencing, and video conferencing. (We will include computer conferencing in the discussion of groupware.)

The distinction between these approaches is related to the type of information that is shared. **Audio conferencing** is a single telephone call involving three or more people participating from at least two locations. If several people on the call are in the same office, they can all participate using a speakerphone, which includes a high-sensitivity microphone and a loudspeaker that can be heard by anyone in a room. **Audiographic conferencing** is an extension of audio conferencing, permitting dispersed participants to see pictures or graphical material at the same time. This is especially useful when the purpose of the meeting is to share information that is difficult to describe, organize, or visualize, such as a spreadsheet or model used to perform calculations under different assumptions (see Figure 5.4). **Video conferencing** is an interactive meeting involving two or more groups of people who can see each other using display screens. The least expensive forms of video conferencing are tiny cameras and four-inch screens added to telephones or separate video conferencing windows displayed on computer screens. In typical business video conferencing, remote participants appear on a television screen.

Video conferencing simulates a face-to-face meeting without requiring unnecessary travel, which absorbs time and energy, not to speak of the cost of airplane and hotel bills. However, the effectiveness of video conferences decreases if the participants lack a prior social bond. For example, doing sales calls via video conference might seem tempting but might not foster the personal relationship needed to succeed in many sales situations.

FIGURE 5.4 Options for teleconferencing

These photos show examples of two extensions of the original idea of the telephone. The first shows an audiographic conference in which financial analysts in different cities are working together on the same spreadsheet model. The second shows how a video conference provides more social presence than a regular phone call and costs much less than getting on an airplane.

On the other hand, Citibank and other banks have begun to experiment with stripping down branch offices that have no tellers but permit customers to open accounts by video conferencing with multilingual staffers in another state.[9]

E-mail, Voice Mail, and Fax

Different-time, different-place communication has been used for centuries in the form of books and letters. Messaging systems make it possible to transmit specific messages to specific individuals or groups of individuals. They use technologies such as electronic mail, voice mail, and fax to make different-time, different-place communication more effective. E-mail, voice mail, pagers, and fax were news to many people ten years ago, but are now so commonplace that they are part of popular culture. Each has a number of advantages but also raises a number of issues, such as:

Social context: E-mail, v-mail, and fax all filter out some of the social context. Ideas communicated using these tools may seem less forceful or caring compared to the same ideas communicated personally. These tools should be used only when social presence is unimportant for understanding the message.

Danger of misinterpretation: The meaning of speech is conveyed partly in the inflection of a voice. Consider the sentences, "That really helped" and "I think you made a mistake." Depending on the context and inflection of the speaker's voice, the first comment could be complimentary or sarcastic. The second could be anything from a mild observation to a reason for firing someone. E-mail and fax provide no clue about inflection, and v-mail filters out body language. People using these tools need to be especially careful not to say things that could be misconstrued, such as jokes.

Power relationships: Use of e-mail and v-mail may create new communication patterns, sometimes involving people who have never communicated previously. With these tools, high-level managers find it easy to obtain information directly from people lower in the organization without going through intermediate managers and chains of command. People in the middle may find themselves out of the loop, as happens with assistants who formerly served as conduits to their bosses.

Privacy and confidentiality: Confidentiality problems may arise because fax outputs can be read by whoever is near the machine, which is often in a clerical work area. The issue of privacy took a bizarre turn in the Iran-gate investigation of illegal arms sales to Iran. Government officials who sold the arms had communicated with each other using e-mail but carefully covered their tracks by erasing the messages. Investigators found backup tapes that had been produced before many of the messages were erased. In this way, the use of e-mail left a trail that eventually aided the investigation.

Electronic junk mail: All three technologies can distribute messages that waste the recipient's time. Users may find that half their e-mail messages are something like "Has anyone seen a green sweater left in room 10-250?" This might seem trivial except that many people receive 50 or more mail messages daily. Junk fax may tie up fax machines when important faxes should be arriving or may use up all the paper in the machine. Some states have considered legislation against it. Companies sending these faxes argue that prohibiting this practice would violate their right to free speech.

Information overload: Messaging capabilities such as v-mail, e-mail, cellular telephones, and pagers have made communication so much more immediate that people in fast-moving firms sometimes feel overwhelmed with the amount of communication they receive. Sometimes there is an expectation that people will respond quickly and thoroughly, even from home. For managers and professionals already overloaded with information and work, this is not always a welcome development. Some complain that e-mail, v-mail, and fax have generated higher workloads, more stress, and an inability to get away from work.

One problem of having three alternative forms of electronic messages is the inconvenience of having to look in too many places to retrieve messages. The idea of **unified messaging** addresses this problem by combining e-mail, voice mail, and sometimes fax into a single mail box that can be accessed from any location. Unified messaging was first available in the mid-1990s and could become more popular as telephone companies, Internet service providers, and Web portals start offering these services to mobile professionals.[10]

Instant Messaging and Chat Rooms

The Internet brought several additional forms of online messaging that have seen wide use. One of these is **instant messaging**, the ability to direct a message to someone on your "buddy list" who happens to be online when you are. All you do is click on a list that highlights your "buddies" who happen to be online, type a message, and it appears immediately on your buddy's screen. The other form of messaging is an online **chat room**, an ongoing, informal computer conference that someone can join, participate in, and then leave. Chat rooms became popular as forums for discussing almost any imaginable topic—teenagers use both chat rooms and instant messaging as a form of socializing. The popularity of these capabilities was a key part of AOL's explosive growth to over 20 million subscribers. Unlike a traditional phone system, instant messaging systems from different carriers do not necessarily link to each other. In fact, Microsoft's Messenger Service was designed to allow its users to talk to AOL users, but AOL blocked access for a variety of competitive and privacy-related reasons.

Instant messaging and chat rooms both have developed into business tools. For example, Yellow Freight System's customer service agents field customer inquiries about rates and delivery times via the same buddy list method that the teenagers use. Similarly, the online brokerage of Bank One urges its customers to add its online nickname to their buddy lists. Among other things, this could be used to inform customers when transactions are completed.[11]

In a reversal that rivals the writeable CD-ROM (a ROM is a read-only memory), some chat rooms have begun to support voice chat, which means using chat room capabilities but talking into a microphone and listening to others using headphones. Hundreds of thousands of people have downloaded voice chat software. For example, the Saddlebrook, New Jersey, Police Department started using voice chat for communication with residents who want to discuss issues with the police while remaining anonymous.[12]

Groupware

Coined in the late 1980s,[13] the term groupware refers to software and related procedures that help teams work together by sharing information and by controlling internal workflows. This relatively new and still somewhat unshaped type of communication system has attained wide recognition due to the increasing need for dispersed teams to work together effectively at a distance as a result of downsizing and rapid organizational change. Groupware starts with messaging but goes further by facilitating access to documents and controlling team-related workflows. Many groupware products are related to specific group-related tasks such as project management, scheduling meetings ("calendaring"), and retrieving data from shared databases. Lotus Notes, a prominent product in this category, is designed for sharing text and images and contains a data structure that is a cross between a table-oriented database and an outline. For example, a law firm in Seattle uses Lotus Notes to permit everyone working on a particular case to have access to the most current memos and other information about that case, even if they are traveling. Other companies use Lotus Notes to store and revise product information for salespeople selling industrial products, thereby replacing the massive three-ring binders they formerly lugged around.

Yet other groupware functions are performed via **computer conferencing**, the exchange of text messages typed into computers from various locations to discuss a

particular issue. When done through the Internet this is sometimes called a **newsgroup**. A computer conference permits people in dispersed locations to combine their ideas in useful ways even though they cannot speak to each other face-to-face. Any conference participant may be able to add new ideas, attach comments to existing messages, or direct comments to specific individuals or groups. Proponents of computer conferencing recognize some disadvantages of working through computers but emphasize major advantages, such as preventing a single forceful individual from dominating a meeting. Also, because everything is done through a computer, a record of how ideas developed is automatically generated.

A different type of groupware product focuses primarily on the flow of work in office settings. These products provide tools for structuring the process by which information for a particular multistep task is managed, transferred, and routed. A typical example is the approval of planned travel expenses. In this case, one person must propose the expenditure and someone else must approve it. The workflow application is set up to make the approval process simple and complete. In effect, groupware is being used as a small transaction processing system for multistep transactions. (See the section on transaction processing.)

Intranets and Extranets

The widespread use of the World Wide Web has led many firms to apply the information-sharing concepts of groupware on a much larger scale by creating a fourth type of communication system, intranets and extranets. **Intranets** are private communication networks that use the type of interface popularized by the Web but are accessible only by authorized employees, contractors, and customers. They are typically used to communicate nonsensitive but broadly useful information such as recent corporate news, general product information, employee manuals, corporate policies, telephone directories, details of health insurance and other employee benefits, and calendars. In some cases employees can use intranets to access and change their personal choices regarding health insurance and other benefits. Once security issues are addressed adequately, intranets for accessing general-purpose corporate data may lead to widespread use of intranets as a front end to transaction processing systems and management information systems described in the following sections.

The simplest intranets basically serve as electronic bulletin boards and employee manuals that make internal company information such as benefits rules, company calendar, sales promotions, and recent press releases readily available to company employees and contractors. Complex intranets can provide access to information in databases around the world. For example, in 2000, Electronic Data Systems (EDS) won a $7 billion contract to create a worldwide intranet for the U.S. Navy and Marines. This intranet would be linked to important military databases and would allow maintenance workers around the world "to pinpoint the availability of an airplane part anywhere in the Navy or Marine Corps system, or to contact the part manufacturer online."[14]

Extranets are private networks that operate similarly to intranets but are directed at customers rather than at employees. Extranets provide many types of information customers need, such as detailed product descriptions, frequently asked questions about different products, maintenance information, warranties, and how to contact customer service and sales offices. Much of this information was formerly difficult for customers to access because paper versions of it at the customer site became scattered and outdated. By using extranets, companies are making this type of information increasingly available at a single interactive site that is easy to navigate.

E B CHECK ✓

k at your college's Web
e. How might it be different if
ere only an intranet directed
nrolled students, instructors,
other employees?

Knowledge Management

Today's leading businesses are increasingly aware that the knowledge of their employees is one of their primary assets. In consulting companies and other organizations that rely heavily on unique competencies and methods, knowledge has more competitive

significance than physical assets because the physical assets can be replaced or replenished more easily.

Knowledge management systems are communication systems designed to facilitate the sharing of knowledge rather than just information. As with groupware, the idea of knowledge management is still emerging and is applied in many different ways in different firms. Tacit knowledge and explicit knowledge require different types of knowledge management efforts. **Tacit knowledge** is understood and applied unconsciously. Examples include an experienced manager's understanding of "human nature" and a member of a culture knowing how to act based on the culture's unwritten norms. It is acquired and shared through experience and social interaction. **Explicit knowledge** is precisely and formally articulated and is often codified in databases of corporate procedures and best practices. The computer applications underlying the management of explicit knowledge are often built on technologies such as intranets, electronic mail, groupware, databases, and search engines. Functions supported by these technologies include codifying knowledge (such as best practices), organizing it in repositories for later access, finding knowledge (using search engines and other schemes), and providing organized ways to find people who possess the required knowledge.[15, 16]

The human element is paramount in both sides of knowledge management. The companies with the best results to date stitch technologies together into a system that operates effectively and that is genuinely supported by the culture. For example, employee reviews in many consulting companies give significant weight to demonstrated contributions to knowledge sharing. This type of recognition is especially important if the firm's culture otherwise encourages internal competition and hoarding of knowledge for personal advancement. In many cases, the most effective use of knowledge requires involvement of the person who is the expert. When a British Petroleum drilling ship in the North Sea encountered an equipment failure, it put the equipment in front of a video camera and used a satellite link to contact a drilling expert in Scotland. His rapid diagnosis of the problem prevented delays and a possible shutdown.[17]

Due to the two sides of knowledge, the tacit and the explicit, different people who refer to knowledge management may mean completely different things. A knowledge management system sold by a software vendor is about codifying and accessing explicit knowledge. The human resources expert Jeffrey Pfeffer has argued that building intranets might give the appearance of knowledge management but in his view it is really just building an infrastructure that can be used "to transfer only explicit, codified information. Talk to people who work at consulting firms. They all have such 'knowledge management systems.' They are almost never used. No one has the time. There are a few simple principles to keep in mind: 1) The most important knowledge is tacit knowledge; 2) tacit knowledge and, for that matter, most explicit knowledge is exchanged best through personal interaction; 3) all work is knowledge work in today's economy; 4) firms lose knowledge when they lose their people."[18]

Group Support Systems

A form of groupware called a **group support system (GSS)** supports communication by helping facilitate meetings. The original idea was an offshoot of DSS research and was originally called group decision support systems (GDSS), although many of the people associated with these systems have shifted the term to GSS because many meetings are directed at brainstorming, discussions, and other purposes that may not be linked directly to decisions.

In its original concept, a GDSS was a specially outfitted conference room containing hardware and software that facilitates meetings (see Figure 5.5). This technology may include advanced presentation devices, computer access to databases, and capabilities permitting the participants in a meeting to communicate electronically. These rooms improve same-time, same-place communication by a group of people working together in a meeting. The meeting's purpose could be anything from brainstorming

This computerized conference room has been used for research and pilot studies of group decision-making. It combines carefully designed physical space with extensive software capabilities for recording and processing ideas, votes, and other data generated by meeting participants.

about possible new product features to reviewing business operations or responding to an emergency. Today's typical GSS capabilities include:[19]

- *Display*. A workstation screen or previously prepared presentation material is displayed to the entire group.
- *Electronic brainstorming*. Participants enter and share comments anonymously through their computer screens.
- *Topic commenting*. Participants add comments to ideas previously generated by themselves or others.
- *Issue analysis*. Participants identify and consolidate key items generated during electronic brainstorming.
- *Voting*. Participants use the computer to vote on topics, with a choice of prioritization methods.
- *Alternative evaluation*. The computer ranks alternative decisions based on preferences entered by users.

GSS has been more of a research topic than common practice in business, although experience to date suggests GSS has significant potential for improving both the efficiency and effectiveness of certain types of decision-making. Typical meetings in a pilot study for internal problem solving at IBM generated a large number of high-quality ideas. The meetings took about half as long as participants' estimates of the length of regular meetings on the same topics.[20] An important GSS phenomenon is the impact of entering and transmitting ideas anonymously. Unlike typical meetings, very little cross-talk occurs during anonymous brainstorming sessions, and participants tend to comment on the topic at hand. Anonymity encourages participation by all members of the group, independent of their status. It tends to reduce groupthink, pressures for conformity, and dominance of forceful individuals. It also tends to heighten conflict

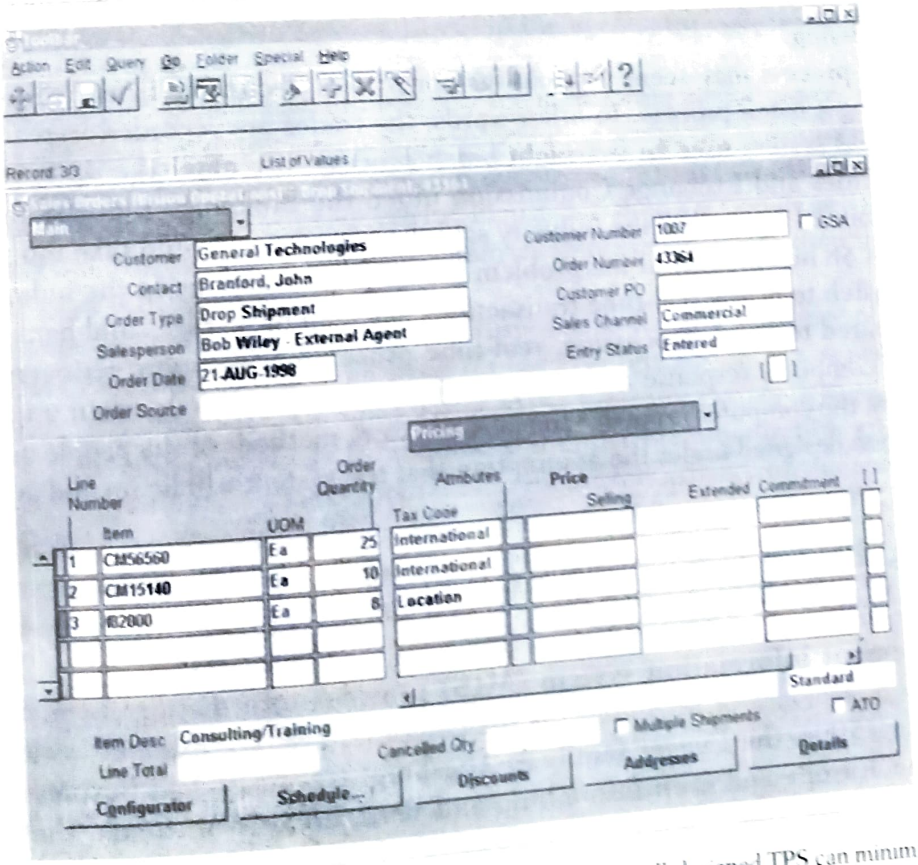
because people's comments in this context may be more assertive and less polite than spoken comments. It remains to be seen whether or not this type of guided group interaction will become commonplace, although some GSS capabilities have already been introduced into computer conferencing.

TRANSACTION PROCESSING SYSTEMS

A **transaction processing system (TPS)** collects and stores data about transactions and sometimes controls decisions made as part of a transaction. A transaction is a business event that generates or modifies data stored in an information system. TPSs were the first computerized information systems that were used widely. We encounter computerized TPSs frequently, including every time we write a check, use a credit card, or pay a bill sent by a company. A TPS used to record a sale and generate a receipt is primarily concerned with collecting and storing data. If the TPS validates a credit card or helps a clerk determine whether to accept a personal check, it also controls decisions made within the transaction. Figure 5.6 contains a TPS data entry screen.

TPSs are designed based on detailed specifications for how the transaction should be performed and how to control the collection of specific data in specific data formats and in accordance with rules, policies, and goals of the organization. Most contain enough structure to enforce rules and procedures for work done by clerks or customer service agents. Some TPSs bypass clerks and totally automate transactions, such as the way ATMs automate deposits and cash withdrawals. A well-designed TPS checks each transaction for easily detectable errors such as missing data, data values that are obviously too high or too low, data values that are inconsistent with other data in the database, and data in the wrong format. It may check for required authorizations for the transaction. Certain TPSs such as airline reservation systems may automate decision-making functions such

Data entry screen from a transaction processing system



This is a data entry screen from a TPS used to enter customer orders. A well-designed TPS can minimize data en errors by automatically filling in data such as customer address or unit price once the user has entered the custor or product number.

as finding the flight that best meets the customer's needs. Finally, when all the information for the transaction has been collected and validated, the TPS stores it in a standard format for later access by others.

As anyone knows who has tried to make a reservation when a computerized reservation system is down, organizations rely heavily on their TPSs. Breakdowns disrupt operations and may even bring business to a complete halt. As a result, a well-designed TPS has backup and recovery procedures that minimize disruptions resulting from computer outages.

Batch versus Real-Time Processing

The two main types of transaction processing are batch processing and real-time processing. With **batch processing**, information for individual transactions is gathered and stored but isn't processed immediately. Later, either on a schedule or when a sufficient number of transactions have accumulated, the transactions are processed to update the database. With **real-time processing**, each transaction is processed immediately. The person providing the information is typically available to help with error correction and receives confirmation of transaction completion. Batch processing was the only feasible form of transaction processing when data were stored only on punched cards or tapes. Real-time transaction processing requires immediate access to an online database.

Batch processing is currently used in some situations where the transaction data comes in on paper, such as in processing checks and airline ticket stubs. A batch approach is also used for generating paychecks and other forms of paper output that will be distributed after a delay. Unfortunately time delays inherent in batch processing may cause significant disadvantages. The central database may never be completely current because of transactions received while the batch was being processed. Worse yet, batching the transactions creates built-in delays, with transactions not completed until the next day in some cases. Even systems with interactive user interfaces may include lengthy delays before transactions are completed. For example, weekend deposits into many ATMs are not posted to the depositor's account until Monday. Even though the ATM's user interface is interactive, the larger system doesn't perform real-time processing.

Batch process may seem very old-fashioned, but securities firms still settle their trades using a batch process. In other words, the trades are recorded in real time, but the payment system uses an overnight batch process that may take up to three days. The Securities and Exchange Commission urged the brokerage industry to settle all trades within 24 hours, but the industry said the conversion would take four years and would cost $8 billion. Part of the problem is that every company in the industry would have to switch to nearly real-time transactions between brokerages and banks.[21]

Compared to batch processing, real-time processing has more stringent requirements for computer response and computer uptime. As is obvious when a travel agent says, "Sorry, the computer is down," the jobs and work methods of the people using a real-time TPS are designed under the assumption that the system will be up and available.

MANAGEMENT AND EXECUTIVE INFORMATION SYSTEMS

A **management information system** (MIS) provides information for managing an organization. The idea of MIS predates the computer age. For example, as long ago as the middle 1500s, the Fugger family in Augsberg, Germany, had business interests throughout Europe and even into China and Peru. To keep in touch, they set up a worldwide news-reporting service through which their agents wrote letters about critical political and economic events in their areas of responsibility. These letters were collected, interpreted, analyzed, and summarized in Augsberg and answered through instructions sent to the family's agents. This paper-based system encompassing plan-

A management report from a hypothetical MIS

Division/ Branch	Sales	Plan	Perf vs Plan	Sales Per Rep	% Repeat Sales
Southeast					
Atlanta	1217	1189	1.02	112	51
Miami	1643	1734	0.95	137	34
New Orleans	1373	1399	0.98	108	44
Tampa	2300	2106	1.09	145	53
Total	6533	6428	1.02	129	46
Midwest					
Chicago	6323	6523	0.97	144	66
Detroit	6845	6448	1.06	137	53
Minneapolis	5783	6300	0.92	160	71
St. Louis	5345	5318	1.01	129	55
Total	24296	24589	0.99	140	61
Far West					
Phoenix	2337	2445	0.96	104	44
Portland	3426	3276	1.05	120	52

This figure represents a management report showing last month's sales results for an office supplies company that is expanding out of its major Midwest markets into the Southeast and Far West.

ning, execution, and control helped the family move more rapidly in the mercantile world than their rivals.[22] Instructions went out to the agents; the agents executed their work; and the agents reported their results.

Computerized MISs generate information for monitoring performance, maintaining coordination, and providing background information about the organization's operation. Users include both managers and the employees who receive feedback about performance indicators such as productivity. Figure 5.7 shows a sample report from a hypothetical MIS. Notice how it provides summary information rather than the details of individual sales transactions.

The concept of MIS emerged partly as a response to the shortcomings of the first computerized TPSs, which often improved transaction processing but provided little information for management. Computerized MISs typically extract and summarize data from TPSs to allow managers to monitor and direct the organization and to provide employees accurate feedback about easily measured aspects of their work. For example, a listing of every sale during a day or week would be extremely difficult to use in monitoring a hardware store's performance. However, the same data could be summarized in measures of performance, such as total sales for each type of item, for each salesperson, and for each hour of the day. The transaction data remains indispensable, and the MIS focuses it for management.

As part of an organization's formal control mechanisms, an MIS provides some structure for the comparatively unstructured task of management by identifying important measures of performance. The fact that everyone knows how performance is measured helps in making decisions and helps managers motivate workers. For example, in a sales group expecting $1,000 per day of evenly distributed sales, the MIS might report that a salesperson met weekly and monthly sales targets but usually did poorly on one group of products. In this typical situation, the MIS reports information but leaves it to the people to decide how to improve performance.

From MIS to EIS

An **executive information system (EIS)** is a highly interactive system providing managers and executives flexible access to information for monitoring operating results and general business conditions. These systems are sometimes called *executive support systems (ESS)*. EIS attempts to take over where the traditional MIS approach falls short. Although sometimes acceptable for monitoring the same indicators over time, the traditional MIS approach of providing prespecified reports on a scheduled basis is too inflexible for many questions executives really care about, such as understanding problems and new situations.

EISs provide executives with internal and competitive information through user-friendly interfaces that can be used by someone with almost no computer-related knowledge. EISs are designed to help executives find the information they need whenever they need it and in whatever form is most useful. Typically, users can choose among numerous tabular or graphical formats. They can also control the level of detail, the triggers for exception conditions, and other aspects of the information displayed. Most EISs focus on providing executives with the background information they need as well as help in understanding the causes of exceptions and surprises. This leaves executives better prepared to discuss issues with their subordinates.

A typical sequence of EIS use is shown in Figure 5.8. The EIS user starts with a menu listing available types of information, such as sales results, manufacturing results, competitive performance, and e-mail messages. The categories are customized for individual executives. The user selects a category from the menu and receives an additional menu identifying available subcategories plus the specific online reports that can be obtained. The executive can often customize these reports by choosing options, such as selecting a subset of the data, sorting, or providing more detail. For example, while looking at last month's sales results, a user might select the branches with less than 2% improvement, sort these sales branches from highest to lowest percentage improvement, and obtain more detail for these branches by looking at results for individual departments within these branches. In addition, users can generate graphical displays such as trend charts and pie charts to make it easier to visualize what is happening.

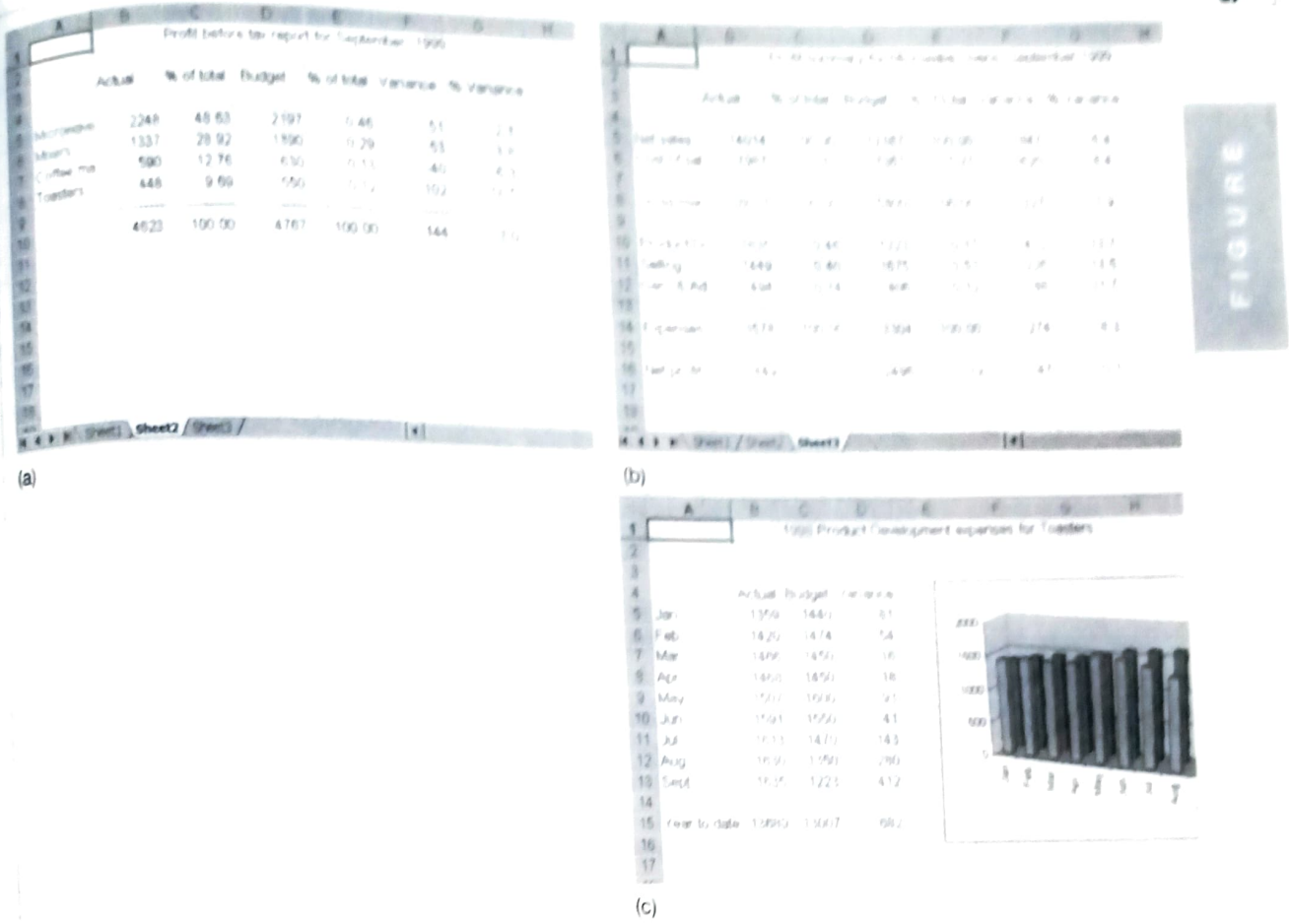
For an EIS to operate, technical staff members must ensure that the right data are available and are downloaded to the EIS from other systems in a timely manner. The data in EISs are usually replenished periodically from internal company databases and external databases. Although technical advances in data display and networking capabilities have made EISs much easier to maintain, EISs continually modified to keep up with current business issues still require major efforts and substantial technical maintenance.

Although EIS users are executives and managers, ideally anyone in a business should be able to get the right information in the right format. Even when commercial EIS software is used, the time and effort to customize and maintain an EIS limits use to high-level managers. Ideally, the flexibility and ease of access built into EIS should also be built into other information systems. Ten years ago, it was much more expensive to provide EIS capabilities to executives. Ten years from now, the interfaces in information systems at all organizational levels may mimic or exceed those in today's EIS.

Do MIS and EIS Really Solve Managers' Problems?

The foregoing discussion describing typical MIS and EIS capabilities said little about whether these information systems actually provide the information managers need. In fact, different managers have very different types of responsibilities. An MIS for a first-line manager deeply involved in the details of how work is done would be very different from an MIS for a high-level manager, who is more concerned with making an entire organization operate effectively. Top managers are also concerned with developing and instilling a long-range vision of where the organization is going. Most introductory management texts start discussing what managers do by identifying the classical

Use of an executive information system



(a) (b) (c)

This sequence, using a spreadsheet, demonstrates how an executive can use an EIS to study a firm's financial results by "drilling down" to understand specific items in more detail. (a) The executive scans the firm's standard financial report summarizing actual versus budgeted revenues and expenses for the month of September. The executive wants to look at the Microwave division in more detail and with an EIS would use a mouse or touch screen to identify the area where more detailed data is needed. (b) The more detailed data for the Microwave division shows that product development expenses are 33.7% over budget for the month. This variance calls for a deeper look. (c) The executive looks at monthly actual versus budget for this category and sees that expenses have not fallen as they were supposed to. This background information will help the executive ask probing questions when discussing the situation with the managers in charge of product development.

management functions, such as planning, organizing, leading, and controlling. After identifying these functions, many texts point out that these functions do not adequately describe what managers actually do.

Figure 5.9 identifies the types of information systems that support a list of managerial roles based on a well-known characterization of managerial work by Mintzberg. The roles are grouped into three categories: interpersonal, informational, and decisional. Even though the mix of roles would differ greatly between the CEO of General Motors and a branch accounting manager, most managers perform most of these roles to some extent. For example, as part of organizing a department, a manager could play interpersonal roles such as figurehead for the organizational effort, leader for meetings, and liaison to other departments. Informational roles in the process could include monitoring activities, disseminating the principles behind the new organization, and serving as organizational spokesperson. Decisional roles could include the entrepreneur defining the new goals, the negotiator resolving conflicts, and the disturbance handler.

Figure 5.9 shows that different types of information systems support the different management roles. The relevance of communication systems to all of the management roles illustrates that management is a highly interactive job. Typical managers spend