Laudon, K. & Laudon, J. (2006)

Management Information Systems: Managing the Digital Firm,

9th ed. Prentice Hall

Chapter 1:
Managing the Digital Firm

Today it is widely recognized that information systems knowledge is essential for managers because most organizations need information systems to survive and prosper. Information systems can help companies extend their reach to faraway locations, offer new products and services, reshape jobs and work flows, and perhaps profoundly change the way they conduct business.

The Competitive Business Environment and the Emerging Digital Firm

Four powerful worldwide changes have altered the business environment. The first change is the emergence and strengthening of the global economy. The second change is the transformation of industrial economies and societies into knowledge- and information-based service economies. The third is the transformation of the business enterprise. The fourth is the emergence of the digital firm. These changes in the business environment and climate, summarized in Table 1-1, pose a number of new challenges to business firms and their management.

Table 1-1	The Changing Contemporary Business Environment
Globalization Management and control in a global marketplace Competition in world markets Global work groups Global delivery systems	**Transformation of the Enterprise** Flattening Decentralization Flexibility Location independence Low transaction and coordination costs Empowerment Collaborative work and teamwork
Transformation of Industrial Economies Knowledge- and information-based economies Productivity New products and services Knowledge: a central productive and strategic asset Time-based competition Shorter product life Turbulent environment Limited employee knowledge base	**Emergence of the Digital Firm** Digitally enabled relationships with customers, suppliers, and employees Core business processes accomplished via digital networks Digital management of key corporate assets Rapid sensing and responding to environmental changes

Emergence of the Global Economy

A growing percentage of the American economy—and other advanced industrial economies in Europe and Asia—depends on imports and exports. Foreign trade, both exports and imports, accounts for more than 25 percent of the goods and services produced in the United States, and even more in countries such as Japan and Germany. Companies are also distributing core business functions in product design, manufacturing, finance, and customer support to locations in other countries where the work can be performed more cost effectively. The success of firms today and in the future depends on their ability to operate globally.
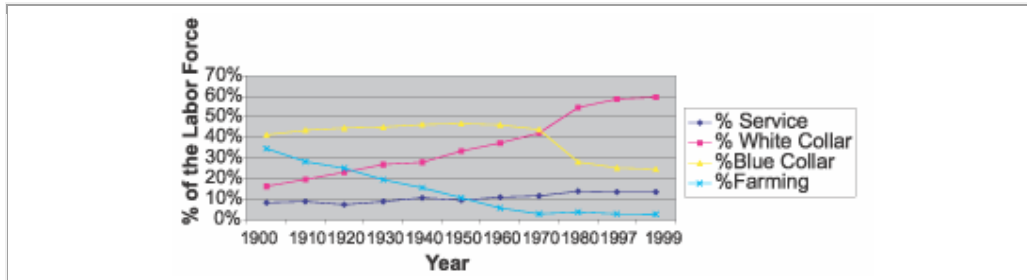

	Figure 1-1	The Growth of the Information Economy

Since the beginning of the twentieth century, the United States has experienced a steady decline in the number of farm workers and blue-collar workers who are employed in factories. At the same time, the country is experiencing a rise in the number of white-collar workers who produce economic value using knowledge and information.

Sources: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States, 2000,* Table 669 and *Historical Statistics of the United States, Colonial Times to 1970,* Vol. 1, Series D 182–232.

Today, information systems provide the communication and analytic power that firms need for conducting trade and managing businesses on a global scale. Controlling the far-flung global corporation—communicating with distributors and suppliers, operating 24 hours a day in different national environments, coordinating global work teams, and servicing local and international reporting needs—is a major business challenge that requires powerful information system responses.

Globalization and information technology also bring new threats to domestic business firms: Because of global communication and management systems, customers now can shop in a worldwide marketplace, obtaining price and quality information reliably 24 hours a day. To become competitive participants in international markets, firms need powerful information and communication systems.

Transformation of Industrial Economies

The United States, Japan, Germany, and other major industrial powers are being transformed from industrial economies to knowledge- and information-based service economies, whereas manufacturing has been moving to low-wage countries. In a knowledge- and information-based economy, knowledge and information are key ingredients in creating wealth.

The knowledge and information revolution began at the turn of the twentieth century and has gradually accelerated. By 1976 the number of white-collar workers employed in offices surpassed the number of farm workers, service workers, and blue-collar workers employed in manufacturing (see Figure 1-1). Today, most people no longer work on farms or in factories but instead are found in sales, education, healthcare, banks, insurance firms, and law firms; they also provide business services like copying, computer programming, or making deliveries. These jobs primarily involve working with, distributing, or creating new knowledge and information. In fact, knowledge and information work now account for a significant 60 percent of the American gross national product and nearly 55 percent of the labor force.

Knowledge and information are becoming the foundation for many new services and products. Knowledge- and information-intense products such as computer games require a great deal of knowledge to produce. Entire new information-based services have sprung up, such as Lexis, Dow Jones News Service, and America Online. These fields are employing millions of people. Knowledge is used more intensively in the production of traditional products as well. In the automobile industry, for instance, both design and production now rely heavily on knowledge and information technology.

In a knowledge- and information-based economy, information technology and systems take on great importance. Knowledge-based products and services of great economic value, such as credit cards, overnight package delivery, and worldwide reservation systems, are based on new information technologies. Information technology constitutes more than 70 percent of the invested capital in service industries such as finance, insurance, and real estate.

Across all industries, information and the technology that delivers it have become critical, strategic assets for business firms and their managers (Leonard-Barton, 1995). Information systems are needed to optimize the flow of information and knowledge within the organization and to help management maximize the firm's knowledge resources. Because employees' productivity depends on the quality of the systems serving them, management decisions about information technology are critically important to the firm's prosperity and survival.

Transformation of the Business Enterprise

There has been a transformation in the possibilities for organizing and managing the business enterprise. Some firms have begun to take advantage of these new possibilities.

The traditional business firm was—and still is—a hierarchical, centralized, structured arrangement of specialists that typically relied on a fixed set of standard operating procedures to deliver a mass-produced product (or service). The new style of business firm is a flattened (less hierarchical), decentralized, flexible arrangement of generalists who rely on nearly instant information to deliver mass-customized products and services uniquely suited to specific markets or customers.

The traditional management group relied—and still relies —on formal plans, a rigid division of labor, and formal rules. The new manager relies on informal commitments and networks to establish goals (rather than formal planning), a flexible arrangement of teams and individuals working in task forces, and a customer orientation to achieve coordination among employees. The new manager appeals to the knowledge, learning, and decision making of individual employees to ensure proper operation of the firm. Once again, information technology makes this style of management possible.

The Emerging Digital Firm

The intensive use of information technology in business firms since the mid-1990s, coupled with equally significant organizational redesign, has created the conditions for a new phenomenon in industrial society— the fully digital firm. The digital firm can be defined along several dimensions. A digital firm is one where nearly all of the organization's *significant business relationships* with customers, suppliers, and employees are digitally enabled and mediated. *Corebusiness processes* are accomplished through digital networks spanning the entire organization or linking multiple organizations. Business processes refer to the unique manner in which work is organized, coordinated, and focused to produce a valuable product or service. Developing a new product, generating and fulfilling an order, or hiring an employee are examples of business processes, and the way organizations accomplish their business processes can be a source of competitive strength. (A detailed discussion of business processes can be found in Chapter 2.) *Key corporate assets*—intellectual property, core competencies, financial, and human assets—are managed through digital means. In a digital firm, any piece of information required to support key business decisions is available at any time and anywhere in the firm. Digital firms *sense and respond* to their environments far more rapidly than traditional firms, giving them more flexibility to survive in turbulent times. Digital firms offer extraordinary opportunities for more global organization and management. By digitally enabling and

streamlining their work, digital firms have the potential to achieve unprecedented levels of profitability and competitiveness.

Digital firms are distinguished from traditional firms by their near total reliance on a set of information technologies to organize and manage. For managers of digital firms, information technology is not simply a useful handmaiden, an enabler, but rather it is the core of the business and the primary management tool.

There are very few fully digital firms today. Yet nearly all firms—especially larger traditional firms—are being driven in this direction by a number of business forces and opportunities. Despite the recent decline in technology investments and Internet-only businesses, firms are continuing to invest heavily in information systems that integrate internal business processes and build closer links with suppliers and customers. Cisco Systems, described in the chapter ending case study, is close to becoming a fully digital firm, using Internet technology to drive every aspect of its business. Procter & Gamble, described in the chapter opening vignette is another digital firm in the making.

Moving from a traditional firm foundation toward a digital firm requires insight, skill, and patience (see the chapter ending case study). Managers need to identify the challenges facing their firms; discover the technologies that will help them meet these challenges; organize their firms and business processes to take advantage of the technology; and create management procedures and policies to implement the required changes. This book is dedicated to helping managers prepare for these tasks.

What is an Information System?

An information system can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making, coordination and control in an organization. In addition to supporting decision making, coordination, and control, information systems may also help managers and workers analyze problems, visualize complex subjects, and create new products.

Information systems contain information about significant people, places, and things within the organization or in the environment surrounding it. By information we mean data that have been shaped into a form that is meaningful and useful to human beings. Data, in contrast, are streams of raw facts representing events occurring in organizations or the physical environment before they have been organized and arranged into a form that people can understand and use.

A brief example contrasting information to data may prove useful. Supermarket checkout counters ring up millions of pieces of data, such as product identification numbers or the cost of each item sold. Such pieces of data can be totaled and analyzed to provide meaningful information such as the total number of bottles of dish detergent sold at a particular store, which brands of dish detergent were selling the most rapidly at that store or sales territory, or the total amount spent on that brand of dish detergent at that store or sales region (see Figure 1-2).
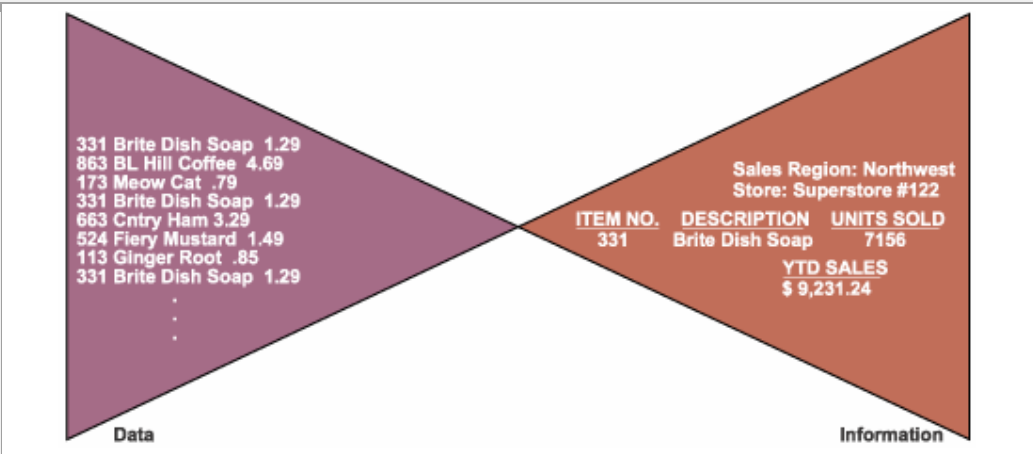
| Figure 1-2 | Data and Information |

Raw data from a supermarket checkout counter can be processed and organized in order to produce meaningful information such as the total unit sales of dish detergent or the total sales revenue from dish detergent for a specific store or sales territory.

Three activities in an information system produce the information that organizations need to make decisions, control operations, analyze problems, and create new products or services. These activities are input, processing, and output (see Figure 1-3). Input captures or collects raw data from within the organization or from its external environment. Processing converts this raw input into a more meaningful form. Output transfers the processed information to the people who will use it or to the activities for which it will be used. Information systems also require feedback, which is output that is returned to appropriate members of the organization to help them evaluate or correct the input stage.
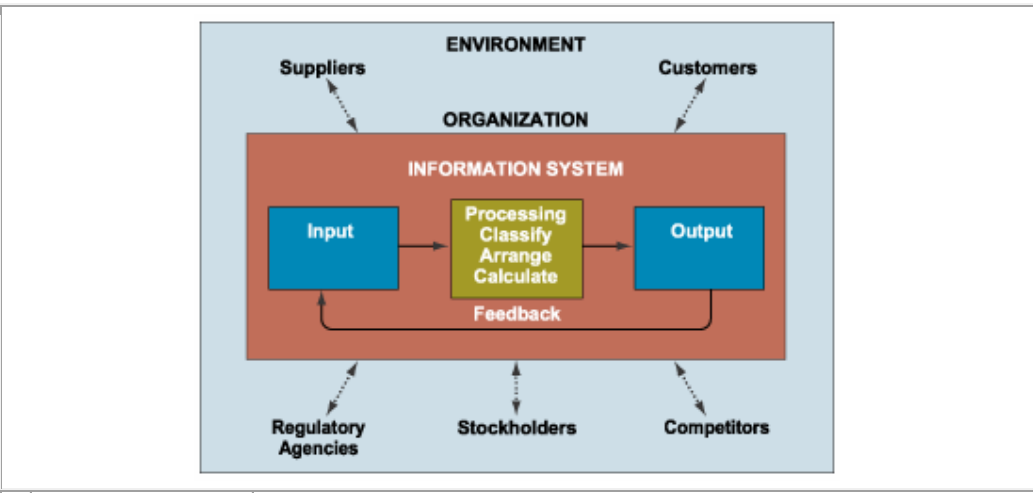
| Figure 1-3 | Functions of an information system |

An information system contains information about an organization and its surrounding environment. Three basic activities—input, processing, and output—produce the information organizations need. Feedback is output returned to appropriate people or activities in the organization to evaluate and refine the input. Environmental factors such as customers, suppliers, competitors, stockholders, and regulatory agencies interact with the organization and its information systems.

In Procter & Gamble's point-of-sale system, the raw input consists of the item identification number, item description, and amount of each item sold along with the retailer's name and identification number. A computer processes these data by comparing the amount of each item sold to the historical sales pattern for that item to determine if the item might soon be out of stock. The system then sends alerts over computers and wireless devices to appropriate store personnel to reorder the item, which become the system outputs. The system thus provides meaningful information, such as lists of what retailer ordered what items, the total number of each item ordered daily, the total number of each item ordered by each retailer, and items that need to be restocked.

Our interest in this book is in formal, organizational computer-based information systems (CBIS) like those designed and used by Procter & Gamble and its customers, suppliers, and employees. Formal systems rest on accepted and fixed definitions of data and procedures for collecting, storing, processing, disseminating, and using these data. The formal systems we describe in this text are structured; that is, they operate in conformity with predefined rules that are relatively fixed and not easily changed. For instance, Procter & Gamble's point-of-sale system requires that all orders include the retailer's name and identification number and a unique number for identifying each item.

Informal information systems (such as office gossip networks) rely, by contrast, on unstated rules of behavior. There is no agreement on what is information, or on how it will be stored and processed. Such systems are essential for the life of an organization, but an analysis of their qualities is beyond the scope of this text.

Formal information systems can be either computer-based or manual. Manual systems use paper-and-pencil technology. These manual systems serve important needs, but they too are not the subject of this text. Computer-based information systems, in contrast, rely on computer hardware and software technology to process and disseminate information. From this point on, when we use the term *information systems,* we are referring to computer-based information systems—formal organizational systems that rely on computer technology. The Window on Technology describes some of the typical technologies used in computer-based information systems today.

Although computer-based information systems use computer technology to process raw data into meaningful information, there is a sharp distinction between a computer and a computer program on the one hand, and an information system on the other. Electronic computers and related software programs are the technical foundation, the tools and materials, of modern information systems. Computers provide the equipment for storing and processing information. Computer programs, or software, are sets of operating instructions that direct and control computer processing. Knowing how computers and computer programs work is important in designing solutions to organizational problems, but computers are only part of an information system. A house is an appropriate analogy. Houses are built with hammers, nails, and wood, but these do not make a house. The architecture, design, setting, landscaping, and all of the decisions that lead to the creation of these features are part of the house and are crucial for solving the problem of putting a roof over one's head. Computers and programs are the hammer, nails, and lumber of CBIS, but alone they cannot produce the information a particular organization needs. To understand information systems, one must understand the problems they are designed to solve, their architectural and design elements, and the organizational processes that lead to these solutions.

A Business Perspective on Information Systems

From a business perspective, an information system is an organizational and management solution, based on information technology, to a challenge posed by the environment. Examine this definition closely because it emphasizes the organizational and managerial nature of information systems: To fully understand information systems, a manager must understand the broader organization, management, and information technology dimensions of systems (see Figure 1-4) and their power to provide solutions to challenges and problems in the business environment. We refer to this broader understanding of information systems, which encompasses an understanding of the management and organizational dimensions of systems as well as the technical dimensions of systems as information systems literacy. Information systems literacy includes a

behavioral as well as a technical approach to studying information systems. Computer literacy, in contrast, focuses primarily on knowledge of information technology.

	Figure 1-4	Information systems are more than computers

Using information systems effectively requires an understanding of the organization, management, and information technology shaping the systems. All information systems can be described as organizational and management solutions to challenges posed by the environment.

Review the diagram at the beginning of the chapter, which reflects this expanded definition of an information system. The diagram shows how Procter & Gamble's Web site, intranet, and sales and replenishment systems solve the business challenge of being a mature business with inefficient business processes. The diagram also illustrates how management, technology, and organization elements work together to create the systems. Each chapter of this text begins with a diagram similar to this one to help you analyze the chapter opening case. You can use this diagram as a starting point for analyzing any information system or information system problem you encounter. The Manager's Toolkit provides guidelines on how to use this framework for problem solving.

Organizations

Information systems are an integral part of organizations. Indeed, for some companies, such as credit reporting firms, without the information system there would be no business. The key elements of an organization are its people, structure, operating procedures, politics, and culture. We introduce these components of organizations here and describe them in greater detail in Chapter 3. Organizations are composed of different levels and specialties. Their structures reveal a clear-cut division of labor. Experts are employed and trained for different functions. The major business functions, or specialized tasks performed by business organizations, consist of sales and marketing, manufacturing and production, finance, accounting, and human resources (see Table 1-2).

Table 1-2	Major Business Functions
Function	**Purpose**
Sales and marketing	Selling the organization's products and services
Manufacturing and production	Producing products and services
Finance	Managing the organization's financial assets (cash, stocks, bonds, etc.)
Accounting	Maintaining the organization's financial records (receipts, disbursements, paychecks, etc.); accounting for the flow of funds
Human resources	Attracting, developing, and maintaining the organization's labor force; maintaining employee records

Chapter 2 provides more detail on these business functions and the ways in which they are supported by information systems. Each chapter of this text now concludes with a Make IT Your Business section showing how chapter topics relate to each of these functional areas. The section also provides page numbers in each chapter where these functional examples can be found. Icons placed next to these functional business examples in the chapter-opening vignettes, Window On boxes, chapter ending case studies, and in the body of the chapters will help you identify them.

An organization coordinates work through a structured hierarchy and formal, standard operating procedures. The hierarchy arranges people in a pyramid structure of rising authority and responsibility. The upper levels of the hierarchy consist of managerial, professional, and technical employees, whereas the lower levels consist of operational personnel.

Standard operating procedures (SOPs) are formal rules that have been developed over a long time for accomplishing tasks. These rules guide employees in a variety of procedures, from writing an invoice to responding to customer complaints. Most procedures are formalized and written down, but others are informal work practices, such as a requirement to return telephone calls from co-workers or customers, that are not formally documented. The firm's business processes, which we defined earlier, are based on its standard operating procedures. Many business processes and SOPs are incorporated into information systems, such as how to pay a supplier or how to correct an erroneous bill.

Organizations require many different kinds of skills and people. In addition to managers, knowledge workers (such as engineers, architects, or scientists) design products or services and create new knowledge and data workers (such as secretaries, bookkeepers, or clerks) process the organization's paperwork. Production or service workers (such as machinists, assemblers, or packers) actually produce the organization's products or services.

Each organization has a unique culture, or fundamental set of assumptions, values, and ways of doing things, that has been accepted by most of its members. Parts of an organization's culture can always be found embedded in its information systems. For instance, the United Parcel Service's concern with placing service to the customer first is an aspect of its organizational culture that can be found in the company's package tracking systems.

Different levels and specialties in an organization create different interests and points of view. These views often conflict. Conflict is the basis for organizational politics. Information systems come out of this cauldron of differing perspectives, conflicts, compromises, and agreements that are a natural part of all organizations. In Chapter 3 we examine these features of organizations in greater detail.

Management

Managers perceive business challenges in the environment, they set the organizational strategy for responding and allocate the human and financial resources to achieve the strategy and coordinate the work. Throughout, they must exercise responsible leadership. Management's job is to "make sense" out of the many situations faced by organizations and formulate action plans to solve organizational problems. The business information systems described in this book reflect the hopes, dreams, and realities of real-world managers.

But managers must do more than manage what already exists. They must also create new products and services and even re-create the organization from time to time. A substantial part of management responsibility is creative work driven by new knowledge and information. Information technology can play a powerful role in redirecting and redesigning the organization. Chapter 3 describes managers' activities and management decision making in detail.

It is important to note that managerial roles and decisions vary at different levels of the organization. Senior managers make long-range strategic decisions about what products and services to produce. Middle managers carry out the programs and plans of senior management. Operational managers are responsible for monitoring the firm's daily activities. All levels of management are expected to be creative, to develop novel solutions to a broad range of problems. Each level of management has different information needs and information system requirements.

Technology

Information technology is one of many tools managers use to cope with change. Computer hardware is the physical equipment used for input, processing, and output activities in an information system. It consists of the following: the computer processing unit; various input, output, and storage devices; and physical media to link these devices together. Chapter 6 describes computer hardware in greater detail.

Computer software consists of the detailed preprogrammed instructions that control and coordinate the computer hardware components in an information system. Chapter 6 explains the importance of computer software in information systems.

Storage technology includes both the physical media for storing data, such as magnetic or optical disk or tape, and the software governing the organization of data on these physical media. More detail on physical storage media can be found in Chapter 6, whereas Chapter 7 covers data organization and access methods.

Communications technology, consisting of both physical devices and software, links the various pieces of hardware and transfers data from one physical location to another. Computers and communications equipment can be connected in networks for sharing voice, data, images, sound, or even video. A network links two or more computers to share data or resources such as a printer. Chapters 8 and 9 provide more details on communications and networking technology and issues.

All of these technologies represent resources that can be shared throughout the organization and constitute the firm's information technology (IT) infrastructure. The IT infrastructure provides the foundation or platform on which the firm can build its specific information systems. Each organization must carefully design and manage its information technology infrastructure so that it has the set of technology services it needs for the work it wants to accomplish with information systems. Chapters 6 through 9 of this text examine each major technology component of information technology infrastructure and show how they all work together to create the technology platform for the organization.

Let us return to UPS's package tracking system in the Window on Technology and identify the organization, management, and technology elements. The organization element anchors the package tracking system in UPS's sales and production functions (the main product of UPS is a service—package delivery). It specifies the required procedures for identifying packages with both sender and recipient information, taking inventory, tracking the packages en route, and providing package status reports for UPS customers and

customer service representatives. The system must also provide information to satisfy the needs of managers and workers. UPS drivers need to be trained in both package pickup and delivery procedures and in how to use the package tracking system so that they can work efficiently and effectively. UPS customers may need some training to use UPS in-house package tracking software or the UPS World Wide Web site. UPS's management is responsible for monitoring service levels and costs and for promoting the company's strategy of combining low cost and superior service. Management decided to use automation to increase the ease of sending a package via UPS and of checking its delivery status, thereby reducing delivery costs and increasing sales revenues. The technology supporting this system consists of handheld computers, barcode scanners, wired and wireless communications networks, desktop computers, UPS's central computer, storage technology for the package delivery data, UPS in-house package tracking software, and software to access the World Wide Web. The result is an information system solution to the business challenge of providing a high level of service with low prices in the face of mounting competition.

> 1.2 Contemporary Approaches to Information Systems

Multiple perspectives on information systems show that the study of information systems is a multidisciplinary field. No single theory or perspective dominates. Figure 1-5 illustrates the major disciplines that contribute problems, issues, and solutions in the study of information systems. In general, the field can be divided into technical and behavioral approaches. Information systems are sociotechnical systems. Though they are composed of machines, devices, and "hard" physical technology, they require substantial social, organizational, and intellectual investments to make them work properly.
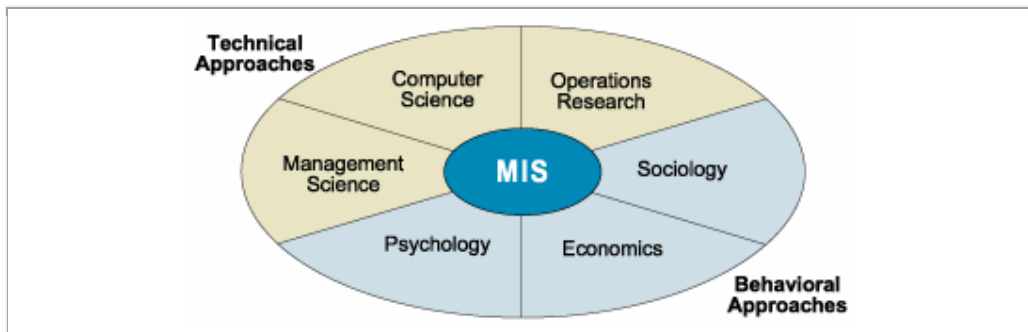

Figure 1-5	Contemporary Approaches to Information Systems

The study of information systems deals with issues and insights contributed from technical and behavioral disciplines.

Technical Approach

The technical approach to information systems emphasizes mathematically based models to study information systems, as well as the physical technology and formal capabilities of these systems. The disciplines that contribute to the technical approach are computer science, management science, and operations research. Computer science is concerned with establishing theories of computability, methods of computation, and methods of efficient data storage and access. Management science emphasizes the development of models for decision-making and management practices. Operations research focuses on mathematical techniques for optimizing selected parameters of organizations, such as transportation, inventory control, and transaction costs.

Behavioral Approach

An important part of the information systems field is concerned with behavioral issues that arise in the development and long-term maintenance of information systems. Issues such as strategic business integration, design, implementation, utilization, and management cannot be explored usefully with the models used in the technical approach. Other behavioral disciplines contribute important concepts and methods. For instance, sociologists study information systems with an eye toward how groups and organizations shape the development of systems and also how systems affect individuals, groups, and organizations. Psychologists study information systems with an interest in how human decision makers perceive and use formal information. Economists study information systems with an interest in what impact systems have on control and cost structures within the firm and within markets.

The behavioral approach does not ignore technology. Indeed, information systems technology is often the stimulus for a behavioral problem or issue. But the focus of this approach is generally not on technical solutions. Instead it concentrates on changes in attitudes, management and organizational policy, and behavior (Kling and Dutton, 1982).

Approach of This Text: Sociotechnical Systems

The study of management information systems (MIS) arose in the 1970s to focus on computer-based information systems aimed at managers (Davis and Olson, 1985). MIS combines the theoretical work of computer science, management science, and operations research with a practical orientation toward developing system solutions to real-world problems and managing information technology resources. It also pays attention to behavioral issues surrounding the development, use, and impact of information systems raised by sociology, economics, and psychology.

Our experience as academics and practitioners leads us to believe that no single perspective effectively captures the reality of information systems. Problems with systems—and their solutions—are rarely all technical or all behavioral. Our best advice to students is to understand the perspectives of all disciplines. Indeed, the challenge and excitement of the information systems field is that it requires an appreciation and tolerance of many different approaches.

Adopting a sociotechnical systems perspective helps to avoid a purely technological approach to information systems. For instance, the fact that information technology is rapidly declining in cost and growing in power does not necessarily or easily translate into productivity enhancement or bottom-line profits.

In this book, we stress the need to optimize the system's performance as a whole. Both the technical and behavioral components need attention. This means that technology must be changed and designed in such a way as to fit organizational and individual needs. At times, the technology may have to be "de-optimized" to accomplish this fit. Organizations and individuals must also be changed through training, learning, and planned organizational change in order to allow the technology to operate and prosper (see, for example, Liker et al., 1987). People and organizations change to take advantage of new information technology. Figure 1-6 illustrates this process of mutual adjustment in a sociotechnical system.
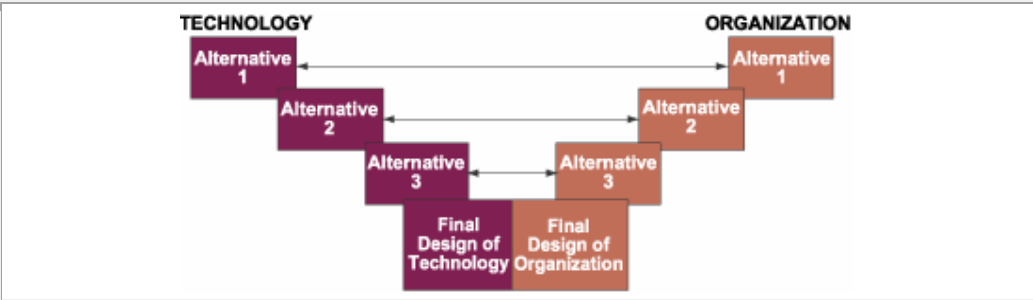
	Figure 1-6	A Sociotechnical Perspective on Information Systems

In a sociotechnical perspective, the performance of a system is optimized when both the technology and the organization mutually adjust to one another until a satisfactory fit is obtained.

> 1.3 Toward the Digital Firm: The New Role of Information Systems in Organizations

Managers cannot ignore information systems because they play such a critical role in contemporary organizations. Today's systems directly affect how managers decide, plan, and manage their employees, and, increasingly, they shape what products are produced, and where, when, and how. Therefore, responsibility for systems cannot be delegated to technical decision makers.

The Widening Scope of Information Systems

Figure 1-7 illustrates the new relationship between organizations and information systems. There is a growing interdependence between business strategy, rules, and procedures on the one hand, and information systems software, hardware, databases, and telecommunications on the other. A change in any of these components often requires changes in other components. This relationship becomes critical when management plans for the future. What a business would like to do in five years often depends on what its systems will be able to do. Increasing market share, becoming the high-quality or low-cost producer, developing new products, and increasing employee productivity depend more and more on the kinds and quality of information systems in the organization.
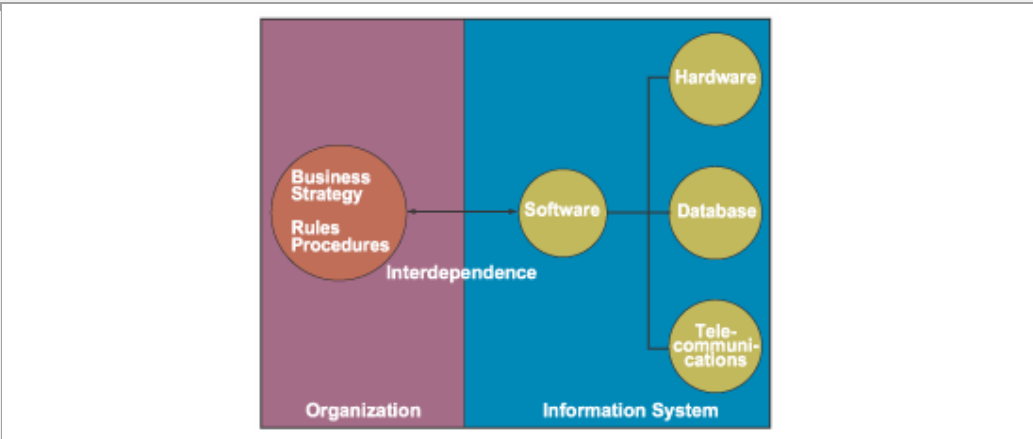
Figure 1-7	The Interdependence between Organizations and Information Systems

In contemporary systems there is a growing interdependence between organizational business strategy, rules, and procedures and the organization's information systems. Changes in strategy, rules, and procedures increasingly require changes in hardware, software, databases, and telecommunications. Existing systems can act as a constraint on organizations. Often, what the organization would like to do depends on what its systems will permit it to do.

A second change in the relationship between information systems and organizations results from the growing reach and scope of system projects and applications. Building and managing systems today involves a much larger part of the organization than it did in the past. As firms become more like "digital firms," the system enterprise extends to customers, vendors, and even industry competitors (see Figure 1-8). Where early systems produced largely technical changes that affected only a few people in the firm, contemporary systems have been bringing about managerial changes (who has what information about whom, when, and how often) and institutional "core" changes (what products and services are produced, under what conditions, and by whom). As companies move toward digital firm organizations, nearly all the firm's managers and employees—as well as customers and vendors—participate in a variety of firm systems, tied together by a digital information web. For instance, what a customer does on a firm's Web site can trigger an employee to make an on-the-spot pricing decision or alert a firm's suppliers of potential "stockout" situations.
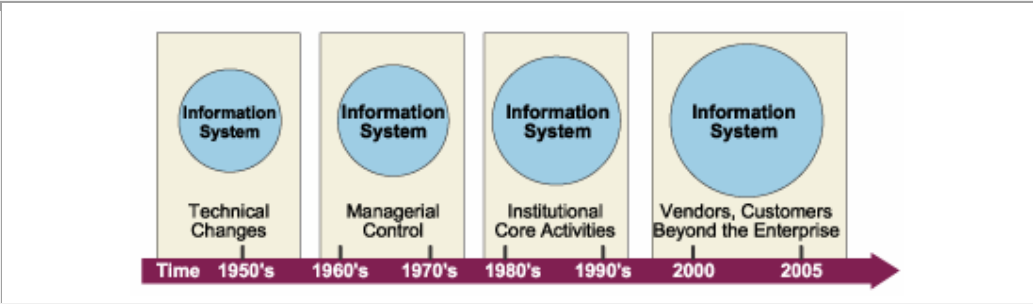
| Figure 1-8 | The Widening Scope of Information Systems |

The widening scope of information systems. Over time, information systems have come to play a larger role in the life of organizations. Early systems brought about largely technical changes that were relatively easy to accomplish. Later systems affected managerial control and behavior and subsequently "core" institutional activities. In the digital firm era, information systems extend far beyond the boundaries of the firm to encompass vendors, customers, and even competitors.

The Network Revolution and the Internet

One reason information systems play such a large role in organizations and affect so many people is the soaring power and declining cost of computer technology. Computing power, which has been doubling every 18 months, has improved the performance of microprocessors over 25,000 times since their invention 30 years ago. With powerful, easy-to-use software, the computer can crunch numbers, analyze vast pools of data, or simulate complex physical and logical processes with animated drawings, sounds, and even tactile feedback.

The soaring power of computer technology has spawned powerful communication networks that organizations can use to access vast storehouses of information from around the world and to coordinate activities across space and time. These networks are transforming the shape and form of business enterprises, creating the foundation for the digital firm.

The world's largest and most widely used network is the Internet. The Internet is an international network of networks that are both commercial and publicly owned. The Internet connects hundreds of thousands of different networks from more than 200 countries around the world. More than 500 million people working in science, education, government, and business use the Internet to exchange information or perform business transactions with other organizations around the globe.

The Internet is extremely elastic. If networks are added or removed or failures occur in parts of the system, the rest of the Internet continues to operate. Through special communication and technology standards, any computer can communicate with virtually any other computer linked to the Internet using ordinary telephone lines. Companies and private individuals can use the Internet to exchange business transactions, text messages, graphic images, and even video and sound, whether they are located next door or on the other side of the globe. Table 1-3 describes some of the Internet's capabilities.

Table 1-3	What You Can Do on the Internet

Function	Description
Communicate and collaborate	Send electronic mail messages; transmit documents and data; participate in electronic conferences
Access information	Search for documents, databases, and library card catalogs; read electronic brochures, manuals, books, and advertisements
Participate in discussions	Join interactive discussion groups; conduct voice transmission
Supply information	Transfer computer files of text, computer programs, graphics, animations, sound, or videos
Find entertainment	Play interactive video games; view short video clips; listen to sound and music clips; read illustrated and even animated magazines and books
Exchange business transactions	Advertise, sell, and purchase goods and services

The Internet is creating a new "universal" technology platform on which to build all sorts of new products, services, strategies, and organizations. It is reshaping the way information systems are being used in business and daily life. By eliminating many technical, geographic, and cost barriers obstructing the global flow of information, the Internet is inspiring new uses of information systems and new business models. The Internet provides the primary technology platform for the digital firm.

Because it offers so many new possibilities for doing business, the Internet capability known as the World Wide Web is of special interest to organizations and managers. The World Wide Web is a system with universally accepted standards for storing, retrieving, formatting, and displaying information in a networked environment. Information is stored and displayed as electronic "pages" that can contain text, graphics, animations, sound, and video. These Web pages can be linked electronically to other Web pages, regardless of where they are located, and viewed by any type of computer. By clicking on highlighted words or buttons on a Web page, you can link to related pages to find additional information, software programs, or still more links to other points on the Web. The Web can serve as the foundation for new kinds of information systems such as those based on Procter & Gamble's Web site described in the chapter opening vignette.

All of the Web pages maintained by an organization or individual are called a Web site. Businesses are creating Web sites with stylish typography, colorful graphics, push-button interactivity, and often sound and video to disseminate product information widely, to "broadcast" advertising and messages to customers, to collect electronic orders and customer data, and, increasingly, to coordinate far-flung sales forces and organizations on a global scale.

In Chapters 4 and 9 we describe the Web and other Internet capabilities in greater detail. We also discuss relevant features of the Internet throughout the text because the Internet affects so many aspects of information systems in organizations.

New Options for Organizational Design: The Digital Firm and the Collaborative Enterprise

The explosive growth in computing power and networks, including the Internet, is turning organizations into networked enterprises, allowing information to be instantly distributed within and beyond the organization. Companies can use this information to improve their internal business processes and to coordinate these

business processes with those of other organizations. These new technologies for connectivity and collaboration can be used to redesign and reshape organizations, transforming their structure, scope of operations, reporting and control mechanisms, work practices, work flows, products, and services. The ultimate end product of these new ways of conducting business electronically is the digital firm.

Flattening Organizations and the Changing Management Process

Large, bureaucratic organizations, which primarily developed before the computer age, are often inefficient, slow to change, and less competitive than newly created organizations. Some of these large organizations have downsized, reducing the number of employees and the number of levels in their organizational hierarchies. For example, when Eastman Chemical Co. split off from Kodak in 1994 it had $3.3 billion in revenue and 24,000 full-time employees. By 2000 it generated $5 billion in revenue with only 17,000 employees (*Information Week,* 2000).

In digital firms, hierarchy and organizational levels do not disappear. But digital firms develop "optimal hierarchies" that balance the decision-making load across an organization, resulting in flatter organizations. Flatter organizations have fewer levels of management, with lower-level employees being given greater decision-making authority (see Figure 1-9). Those employees are empowered to make more decisions than in the past, they no longer work standard nine-to-five hours, and they no longer necessarily work in an office. Moreover, such employees may be scattered geographically, sometimes working half a world away from the manager.
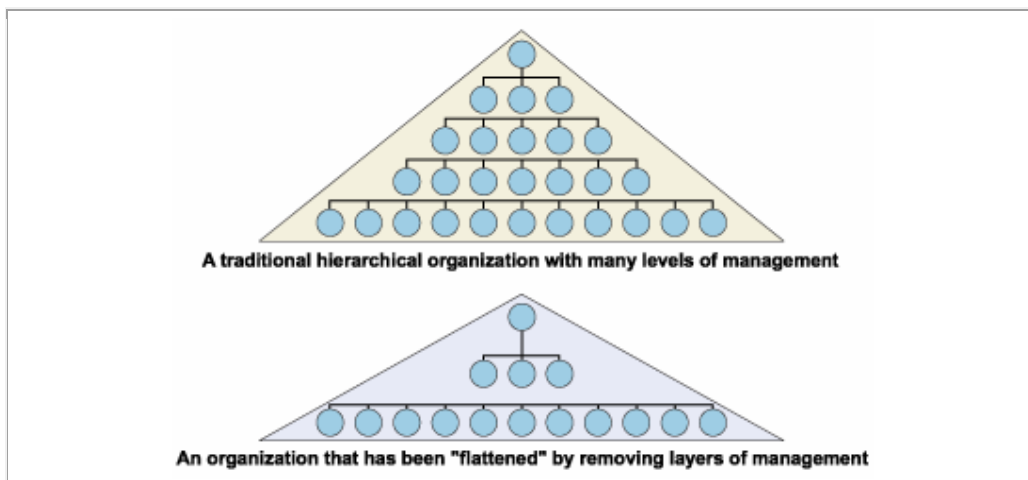

A traditional hierarchical organization with many levels of management

An organization that has been "flattened" by removing layers of management

| Figure 1-9 | Flattening Organizations |

Information systems can reduce the number of levels in an organization by providing managers with information to supervise larger numbers of workers and by giving lower-level employees more decision-making authority.

These changes mean that the management span of control has also been broadened, allowing high-level managers to manage and control more workers spread over greater distances. Many companies have eliminated thousands of middle managers as a result of these changes. AT&T, IBM, and General Motors are only a few of the organizations that have eliminated more than 30,000 middle managers in one fell swoop.

Information technology is also recasting the management process by providing powerful new tools for more precise planning, forecasting, and monitoring. For instance, it is now possible for managers to obtain information on organizational performance down to the level of specific transactions from just about anywhere in the organization at any time. Product managers at Frito-Lay Corporation, the world's largest manufacturer of salty snack foods, can know within hours precisely how many bags of Fritos have sold on any street in America at its customers' stores, how much they sold for, and what the competition's sales volumes and prices are. (The Chapter 10 case study provides more detail about this company.)

Separating Work from Location

Communications technology has eliminated distance as a factor for many types of work in many situations. Salespersons can spend more time in the field with customers and have more up-to-date information with them while carrying much less paper. Many employees can work remotely from their homes or cars, and companies can reserve space at smaller central offices for meeting clients or other employees. Collaborative teamwork across thousands of miles has become a reality as designers work on a new product together even if they are located on different continents. Lockheed Martin Aeronautics developed a real-time system for collaborative product design and engineering based on the Internet, which it uses to coordinate tasks with its partners such as BAE and Northrup Grumman. Engineers from all three companies work jointly on designs over the Internet. Previously, the company and its partners worked separately on designs, hammering out design differences in lengthy face-to-face meetings. A drawing that once took 400 hours now takes 125 and the design phase of projects has been cut in half (Konicki, 2001).

Reorganizing Work Flows

Information systems have been progressively replacing manual work procedures with automated work procedures, work flows, and work processes. Electronic work flows have reduced the cost of operations in many companies by displacing paper and the manual routines that accompany it. Improved work flow management has enabled many corporations not only to cut costs significantly but also to improve customer service at the same time. For instance, insurance companies can reduce processing of applications for new insurance from weeks to days (see Figure 1-10).
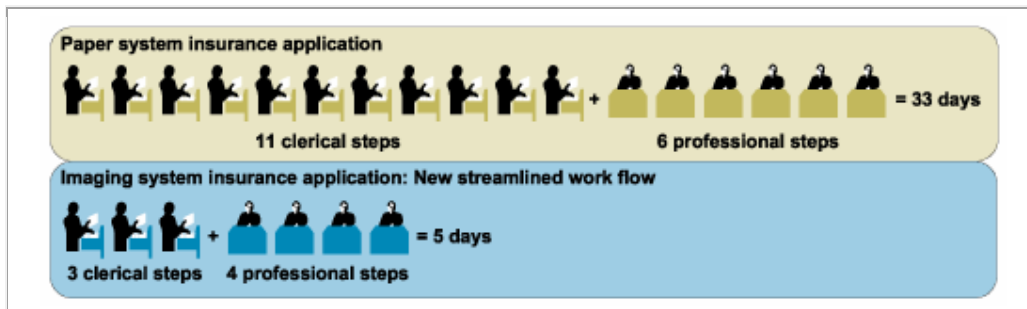

Figure 1-10	Redesigned Work Flow for Insurance Underwriting

An application requiring 33 days in a paper system would only take five days using computers, networks, and a streamlined work flow.

Redesigned work flows can have a profound impact on organizational efficiency and can even lead to new organizational structures, products, and services. We discuss the impact of restructured work flows on organizational design in greater detail in Chapters 3 and 12.

Increasing Flexibility of Organizations

Companies can use communications technology to organize in more flexible ways, increasing their ability to sense and respond to changes in the marketplace and to take advantage of new opportunities. Information systems can give both large and small organizations additional flexibility to overcome some of the limitations posed by their size. Table 1-4 describes some of the ways in which information technology can help small companies act "big" and help big companies act "small." Small organizations can use information systems to acquire some of the muscle and reach of larger organizations. They can perform coordinating activities, such as processing bids or keeping track of inventory, and many manufacturing tasks with very few managers, clerks, or production workers.

Table 1-4	How Information Technology Increases Organizational Flexibility

Small Companies

Desktop machines, inexpensive computer-aided design (CAD) software, and computer-controlled machine tools provide the precision, speed, and quality of giant manufacturers.

Information immediately accessed by telephone and communications links eliminates the need for research staff and business libraries.

Managers can easily obtain the information they need to manage large numbers of employees in widely scattered locations.

Large Companies

Custom manufacturing systems allow large factories to offer customized products in small quantities.

Massive databases of customer purchasing records can be analyzed so that large companies know their customers' needs and preferences as easily as local merchants.

Information can be easily distributed down the ranks of the organization to empower lower-level employees and work groups to solve problems.

Large organizations can use information technology to achieve some of the agility and responsiveness of small organizations. One aspect of this phenomenon is mass customization, the ability to offer individually tailored products or services on a large scale. Information systems can make the production process more flexible so that products can be tailored to each customer's unique set of requirements (Zipkin, 2001). Software and computer networks can be used to link the plant floor tightly with orders, design, and purchasing and to finely control production machines so that products can be turned out in greater variety and easily customized with no added cost for small production runs. For example, Levi Strauss has equipped its stores with an option called Original Spin, which allows customers to design jeans to their own specifications, rather than picking the jeans off the rack. Customers enter their measurements into a personal computer, which then transmits the customer's specifications over a network to Levi's plants. The company is able to produce the custom jeans on the same lines that manufacture its standard items. There are almost no extra production costs because the process does not require additional warehousing, production overruns, and inventories. Lands' End has implemented a similar system for customizing chino slacks that allows customers to enter their measurements over its Web site.

A related trend is micromarketing, in which information systems can help companies pinpoint tiny target markets for these finely customized products and services—as small as individualized "markets of one." We discuss micromarketing in more detail in Chapters 2, 3, and 11.

Redefining Organizational Boundaries: New Avenues for Collaboration

A key feature of the emerging digital firm is the ability to conduct business across firm boundaries almost as efficiently and effectively as it can conduct business within the firm. Networked information systems allow companies to coordinate with other organizations across great distances. Transactions such as payments and purchase orders can be exchanged electronically among different companies, thereby reducing the cost of obtaining products and services from outside the firm. Organizations can also share business data, catalogs,

or mail messages through networks. These networked information systems can create new efficiencies and new relationships between an organization, its customers, and suppliers, redefining organizational boundaries.

For example, the Toyota Motor Corporation is networked to suppliers, such as the Dana Corporation of Toledo, Ohio, a tier-one supplier of chassis, engines, and other major automotive components. Through this electronic link, the Dana Corporation monitors Toyota production and ships components exactly when needed (McDougall, 2001). Toyota and Dana have thus become linked business partners with mutually shared responsibilities.

The information system linking Toyota to its supplier is called an interorganizational information system. Systems linking a company to its customers, distributors, or suppliers are termed interorganizational systems because they automate the flow of information across organizational boundaries. Digital firms use interorganizational systems to link with suppliers, customers, and sometimes even competitors, to create and distribute new products and services without being limited by traditional organizational boundaries or physical locations. For example, Cisco Systems, described in the chapter ending case study, does not manufacture the networking products it sells; it uses other companies, such as Flextronics, for this purpose. Cisco uses the Internet to transmit orders to Flextronics and to monitor the status of orders as they are being shipped. (More detail on Flextronics can be found in the Chapter 2 opening vignette.)

Many of these interorganizational systems are becoming increasingly based on Web technology and providing more intense sharing of knowledge, resources, and business processes than in the past. Firms are using these systems to work jointly with suppliers and other business partners on product design and development and on the scheduling and flow of work in manufacturing, procurement, and distribution. These new levels of interfirm collaboration and coordination can lead to higher levels of efficiency, value to customers, and ultimately significant competitive advantage (see the Window on Organizations).

The Digital Firm: Electronic Commerce, Electronic Business, and New Digital Relationships

The changes we have just described represent new ways of conducting business electronically both inside and outside the firm that can ultimately result in the creation of digital firms. Increasingly, the Internet is providing the underlying technology for these changes. The Internet can link thousands of organizations into a single network, creating the foundation for a vast electronic marketplace. An electronic market is an information system that links together many buyers and sellers to exchange information, products, services, and payments. Through computers and networks, these systems function like electronic intermediaries, with lowered costs for typical marketplace transactions, such as matching buyers and sellers, establishing prices, ordering goods, and paying bills (Bakos, 1998). Buyers and sellers can complete purchase and sale transactions digitally, regardless of their location.

A vast array of goods and services are being advertised, bought, and exchanged worldwide using the Internet as a global marketplace. Companies are furiously creating eye-catching electronic brochures, advertisements, product manuals, and order forms on the World Wide Web. All kinds of products and services are available on the Web, including fresh flowers, books, real estate, musical recordings, electronics, and steaks. Even electronic financial trading has arrived on the Web for stocks, bonds, mutual funds, and other financial instruments.

Increasingly the Web is being used for business-to-business transactions as well. For example, airlines can use the Boeing Corporation's Web site to order parts electronically and check the status of their orders. Altranet Energy Technologies of Houston operates an on-line marketplace called altranet.com where many different energy industry suppliers and buyers can meet any time of day or night to trade natural gas, liquids, electricity, and crude oil in a spot market for immediate delivery. Participants can select their trading partners, confirm transactions, and obtain credit and insurance.

The global availability of the Internet for the exchange of transactions between buyers and sellers has fueled the growth of electronic commerce. Electronic commerce is the process of buying and selling goods and services electronically with computerized business transactions using the Internet, networks, and other
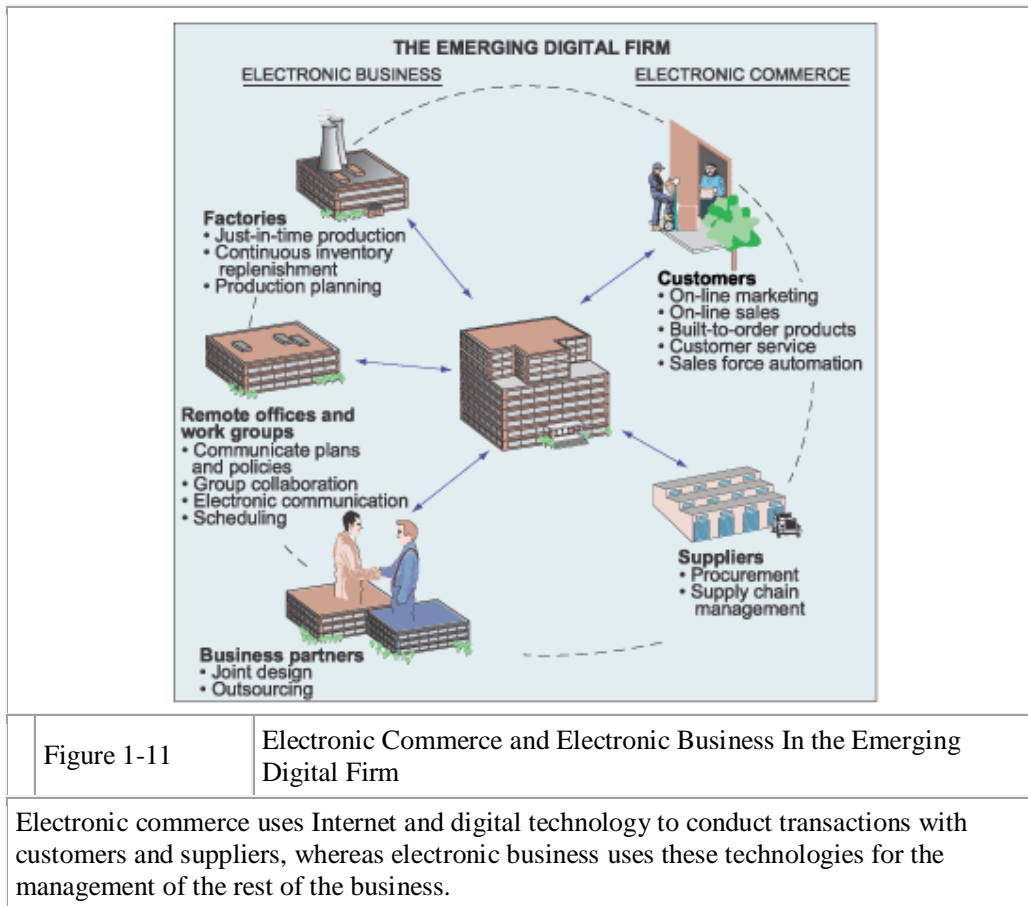
digital technologies. It also encompasses activities supporting those market transactions, such as advertising, marketing, customer support, delivery, and payment. By replacing manual and paper-based procedures with electronic alternatives, and by using information flows in new and dynamic ways, electronic commerce can accelerate ordering, delivery, and payment for goods and services while reducing companies' operating and inventory costs.

The Internet has emerged as the primary technology platform for electronic commerce. Equally important, Internet technology is facilitating management of the rest of the business—publishing employee personnel policies, reviewing account balances and production plans, scheduling plant repairs and maintenance, and revising design documents. Companies are taking advantage of the connectivity and ease of use of Internet technology to create internal corporate networks called intranets that are based on Internet technology. The chapter opening vignette described how Procter & Gamble set up a private intranet for employees to publish reports, charts, and their ideas for improving the company. The number of these private intranets for organizational communication, collaboration, and coordination is soaring. In this text, we use the term electronic business to distinguish these uses of Internet and digital technology for the management and coordination of other business processes from electronic commerce.

The Window on Organizations showed how Li & Fung allowed its suppliers and business partners to access portions of its private intranet. Private intranets extended to authorized users outside the organization are called extranets, and firms use such networks to coordinate their activities with other firms for electronic commerce and electronic business. Table 1-5 lists some examples of electronic commerce and electronic business.

Table 1-5	Examples of Electronic Commerce and Electronic Business

Electronic Commerce

Drugstore.com operates a virtual pharmacy on the Internet selling prescription medicine and over-the-counter health, beauty, and wellness products. Customers can input their orders via Drugstore.com's Web site and have their purchases shipped to them.

Travelocity provides a Web site that can be used by consumers for travel and vacation planning. Visitors can find out information on airlines, hotels, vacation packages, and other travel and leisure topics, and they can make airline and hotel reservations on-line through the Web site.

Milwaukee Electric Tool, a subsidiary of the **Atlas Copco AB** global industrial machine tools conglomerate based in Stockholm, created a secure sales extranet that allows its distributors to search the company's product catalog and order equipment.

Electronic Business

Roche Bioscience scientists worldwide use an intranet to share research results and discuss findings. The intranet also provides a company telephone directory and newsletter.

Texas Instruments uses an intranet to provide employees with a consolidated report of all of their compensation and benefits, including pension plans, 401K employee savings plans, and stock purchase plans. Employees can use charts and modeling tools to see the value of their portfolios and benefits now and in the future.

Dream Works SKG uses an intranet to check the daily status of projects, including animation objects, and to coordinate movie scenes.

Figure 1-11 illustrates a digital firm making intensive use of Internet and digital technology for electronic commerce and electronic business. Information can flow seamlessly among different parts of the company and between the company and external entities—its customers, suppliers, and business partners. Organizations will move toward this digital firm vision as they use the Internet, intranets, and extranets to manage their internal processes and their relationships with customers, suppliers, and other external entities.

Figure 1-11	Electronic Commerce and Electronic Business In the Emerging Digital Firm

Electronic commerce uses Internet and digital technology to conduct transactions with customers and suppliers, whereas electronic business uses these technologies for the management of the rest of the business.

Both electronic commerce and electronic business can fundamentally change the way business is conducted. To use the Internet and other digital technologies successfully for electronic commerce, electronic business, and the creation of digital firms, organizations may have to redefine their business models, reinvent business processes, change corporate cultures, and create much closer relationships with customers and suppliers. We discuss these issues in greater detail in following chapters.

> ## 1.4 Learning to Use Information Systems: New Opportunities with Technology

Although information systems are creating many exciting opportunities for both businesses and individuals, they are also a source of new problems, issues, and challenges for managers. In this course, you will learn about both the challenges and opportunities information systems present, and you will be able to use information technology to enrich your learning experience.

The Challenge of Information Systems: Key Management Issues

Although information technology is advancing at a blinding pace, there is nothing easy or mechanical about building and using information systems. There are five key challenges confronting managers:

1. **The Strategic Business Challenge: Realizing the Digital Firm: How can businesses use information technology to become competitive, effective, and digitally enabled?** Creating a digital firm and obtaining benefits is a long and difficult journey for most organizations. Despite heavy information technology investments, many organizations are not obtaining significant business benefits, nor are they becoming digitally enabled. The power of computer hardware and software has grown much more rapidly than the ability of organizations to apply and use this technology. To fully benefit from information technology, realize genuine productivity, and take advantage of digital firm capabilities, many organizations actually need to be redesigned. They will have to make fundamental changes in organizational behavior, develop new business models, and eliminate the inefficiencies of outmoded organizational structures. If organizations merely automate what they are doing today, they are largely missing the potential of information technology.

2. **The Globalization Challenge: How can firms understand the business and system requirements of a global economic environment?** The rapid growth in international trade and the emergence of a global economy call for information systems that can support both producing and selling goods in many different countries. In the past, each regional office of a multinational corporation focused on solving its own unique information problems. Given language, cultural, and political differences among countries, this focus frequently resulted in chaos and the failure of central management controls. To develop integrated, multinational, information systems, businesses must develop global hardware, software, and communications standards; create cross-cultural accounting and reporting structures (Roche, 1992); and design transnational business processes.

3. **The Information Architecture and Infrastructure Challenge: How can organizations develop an information architecture and information technology infrastructure that can support their goals when business conditions and technologies are changing so rapidly?** Meeting the business and technology challenges of today's digital economy requires redesigning the organization and building a new information architecture and information technology (IT) infrastructure.

   Information architecture is the particular form that information technology takes in an organization to achieve selected goals or functions. It is a design for the business application systems that serve each functional specialty and level of the organization and the specific ways that they are used by each organization. As firms move toward digital firm organizations and technologies, information architectures are increasingly being designed around business processes and clusters of system applications spanning multiple functions and organizational levels (Kalakota and Robinson, 2001). Because managers and employees directly interact with these systems, it is critical for organizational success that the information architecture meet business requirements now and in the future.

   Figure 1-12 illustrates the major elements of information architecture that managers will need to develop now and in the future. The architecture shows the firm's business application systems for each of the major functional areas of the organization, including sales and marketing, manufacturing, finance, accounting, and human resources. It also shows application systems supporting business processes spanning multiple organizational levels and functions within the enterprise and extending outside the enterprise to systems of suppliers, distributors, business partners, and customers. The firm's IT infrastructure provides the technology platform for this architecture. Computer hardware, software, data and storage technology, networks, and human resources required to operate the equipment constitute the shared IT resources of the firm and are available to all of its applications. Contemporary IT infrastructures are linked to public infrastructures such as the Internet. Although this technology platform is typically operated by technical personnel, general management must decide how to allocate the resources it has assigned to hardware, software, data storage, and telecommunications networks to make sound information technology investments (Weill and Broadbent, 1997 and 1998).
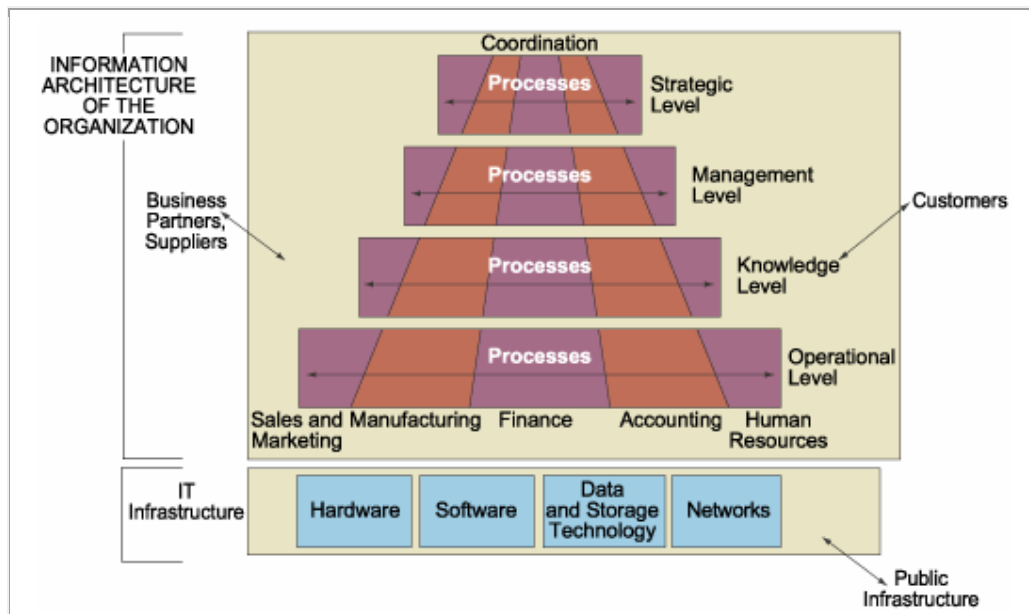
Figure 1-12	Information Architecture and Information Technology Infrastructure

Today's managers must know how to arrange and coordinate the various computer technologies and business system applications to meet the information needs of each level of the organization, and the needs of the organization as a whole.

Typical questions regarding information architecture and IT infrastructure facing today's managers include the following: Should the corporate sales data and function be distributed to each corporate remote site, or should they be centralized at headquarters? Should the organization build systems to connect the entire enterprise or separate islands of applications? Should the organization extend its infrastructure outside its boundaries to link to customers or suppliers? There is no one right answer to each of these questions (see Allen and Boynton, 1991). Moreover, business needs are constantly changing, which requires the IT architecture to be reassessed continually (Feeny and Willcocks, 1998).

Creating the information architecture and IT infrastructure for a digital firm is an especially formidable task. Most companies are crippled by fragmented and incompatible computer hardware, software, telecommunications networks, and information systems that prevent information from flowing freely between different parts of the organization. Although Internet standards are solving some of these connectivity problems, creating data and computing platforms that span the enterprise—and, increasingly, link the enterprise to external business partners—is rarely as seamless as promised. Many organizations are still struggling to integrate their islands of information and technology into a coherent architecture. Chapters 6 through 9 provide more detail on information architecture and IT infrastructure issues.

4. **The Information Systems Investment Challenge: How can organizations determine the business value of information systems?** A major problem raised by the development of powerful, inexpensive computers involves not technology but management and organizations. It's one thing to use information technology to design, produce, deliver, and maintain new products. It's another thing to make money doing it. How can organizations obtain a sizable payoff from their investment in information systems?

Engineering massive organizational and system changes in the hope of positioning a firm strategically is complicated and expensive. Senior management can be expected to ask these questions: Are we receiving the kind of return on investment from our systems that we should be? Do our competitors get more? Understanding the costs and benefits of building a single system is

difficult enough; it is daunting to consider whether the entire systems effort is "worth it." Imagine, then, how a senior executive must think when presented with a major transformation in information architecture and IT infrastructure—a bold venture in organizational change costing tens of millions of dollars and taking many years.

5. **The Responsibility and Control Challenge: How can organizations ensure that their information systems are used in an ethically and socially responsible manner?** How can we design information systems that people can control and understand? Although information systems have provided enormous benefits and efficiencies, they have also created new problems and challenges of which managers should be aware. Table 1-6 describes some of these problems and challenges.

Table 1-6	Positive and Negative Impacts of Information Systems

Benefit of Information Systems	Negative Impact
Information systems can perform calculations or process paperwork much faster than people.	By automating activities that were previously performed by people, information systems may eliminate jobs.
Information systems can help companies learn more about the purchase patterns and preferences of their customers.	Information systems may allow organizations to collect personal details about people that violate their privacy.
Information systems provide new efficiencies through services such as automated teller machines (ATMs), telephone systems, or computer-controlled airplanes and air terminals.	Information systems are used in so many aspects of everyday life that system outages can cause shutdowns of businesses or transportation services, paralyzing communities.
Information systems have made possible new medical advances in surgery, radiology, and patient monitoring.	Heavy users of information systems may suffer repetitive stress injury, technostress, and other health problems.
The Internet distributes information instantly to millions of people across the world.	The Internet can be used to distribute illegal copies of software, books, articles, and other intellectual property.

Many chapters of this text describe scenarios that raise these ethical issues, and Chapter 5 is devoted entirely to this topic. A major management challenge is making informed decisions that are sensitive to the negative consequences of information systems as well to the positive ones.

Managers will also be faced with ongoing problems of security and control. Information systems are so essential to business, government, and daily life that organizations must take special steps to ensure that they are accurate, reliable, and secure. A firm invites disaster if it uses systems that don't work as intended, that don't deliver information in a form that people can interpret correctly and use, or that have control rooms where controls don't work or where instruments give false signals. Information systems must be designed so that they function as intended and so that humans can control the process.

Managers will need to ask: Can we apply high quality assurance standards to our information systems, as well as to our products and services? Can we build information systems that respect people's rights of

privacy while still pursuing our organization's goals? Should information systems monitor employees? What do we do when an information system designed to increase efficiency and productivity eliminates people's jobs?

This text is designed to provide future managers with the knowledge and understanding required to deal with these challenges. To further this objective, each succeeding chapter begins with a Management Challenges box that outlines the key issues of which managers should be aware.

Integrating Text with Technology: New Opportunities for Learning

In addition to the changes in business and management that we have just described, we believe that information technology creates new opportunities for learning that can make the MIS course more meaningful and exciting. We have provided a Web site and an interactive multimedia CD-ROM for integrating the text with leading-edge technology.

The Internet Connection icon in the chapter directs you to Web sites for which we have provided additional exercises and projects related to the concepts and organizations described in that particular chapter. For each chapter, you will also find an Electronic Commerce or Electronic Business project where you can use Web research and interactive software at various company Web sites to solve specific problems. A graded on-line interactive Study Guide contains questions to help you review what you have learned and test your mastery of chapter concepts. You can also use the Laudon Web site to find links to additional on-line case studies, international resources, and technology updates.

An interactive CD-ROM multimedia version of the text features bullet text summaries of key points in each chapter, full-color graphics and photos, Web links to the companion Web site, videos, interactive quizzes, Dynamic Blackboard, and a hyperlinked digital glossary. You can use the CD-ROM as an interactive study guide or as an alternative to the traditional text.

Application software exercises require students to use spreadsheet, database, Web browser, and other application software in hands-on projects related to chapter concepts. They have been redesigned for this edition to make them more challenging and relevant to chapter topics. Students can apply the application software skills they have learned in other courses to real-world business problems. You can find these exercises following the Review Questions at the end of each chapter and both the exercises and their data files on the Laudon Web site.

New to this edition are longer, comprehensive projects concluding each major section of the text. These projects require students to apply what they have learned to more demanding problems, such as analyzing enterprise system requirements, developing an Internet business model, redesigning business processes, and designing a corporate knowledge intranet. Some of these projects require use of the Web.

You will find a Tools for Interactive Learning section with this icon toward the end of every chapter to show how you can use the Web and interactive multimedia to enrich your learning experience.

> Management Wrap-Up

Managers are problem solvers who are responsible for analyzing the many challenges confronting organizations and for developing strategies and action plans. Information systems are one of their tools, delivering the information required for solutions. Information systems both reflect management decisions and serve as instruments for changing the management process.

Information systems are rooted in organizations, an outcome of organizational structure,culture, politics, work flows, and standard operating procedures. They are instruments for organizational change, making it

possible to recast these organizational elements into new business models and redraw organizational boundaries. Advances in information systems are accelerating the trend toward globalized, knowledge-driven economies and flattened, flexible, decentralized organizations that can coordinate with other organizations across great distances.

A network revolution is under way. Information systems technology is no longer limited to computers but consists of an array of technologies that enable computers to be networked together to exchange information across great distances and organizational boundaries. The Internet provides global connectivity and a flexible platform for the seamless flow of information across the enterprise and between the firm and its customers and suppliers.

For Discussion

1. Information systems are too important to be left to computer specialists. Do you agree? Why or why not?

2. As computers become faster and cheaper and the Internet becomes more widely used, most of the problems we have with information systems will disappear. Do you agree? Why or why not?

Summary

1. *What is the role of information systems in today's competitive business environment?* Information systems have become essential for helping organizations deal with changes in global economies and the business enterprise. Information systems provide firms with communication and analytic tools for conducting trade and managing businesses on a global scale. Information systems are the foundation of new knowledge-based products and services in knowledge economies and help firms manage their knowledge assets. Information systems make it possible for businesses to adopt flatter, more decentralized structures and more flexible arrangements of employees and management. Organizations are trying to become more competitive and efficient by transforming themselves into digital firms where nearly all core business processes and relationships with customers, suppliers, and employees are digitally enabled.

2. *What exactly is an information system? What do managers need to know about information systems?* The purpose of an information system is to collect, store, and disseminate information from an organization's environment and internal operations to support organizational functions and decision making, communication, coordination, control, analysis, and visualization. Information systems transform raw data into useful information through three basic activities: input, processing, and output. From a business perspective, an information system represents an organizational and management solution based on information technology to a challenge posed by the environment.

   Information systems literacy requires an understanding of the organizational and management dimensions of information systems as well as the technical dimensions addressed by computer literacy. Information systems literacy draws on both technical and behavioral approaches to studying information systems. Both perspectives can be combined into a sociotechnical approach to systems.

3. *How are information systems transforming organizations and management?* The kinds of systems built today are very important for the organization's overall performance, especially in today's highly globalized and information-based economy. Information systems are driving both daily operations and organizational strategy. Powerful computers, software, and networks, including the Internet, have helped organizations become more flexible, eliminate layers of management, separate work from location, coordinate with suppliers and customers, and restructure work flows, giving new powers to both line workers and management. Information technology provides managers with tools for more precise planning, forecasting, and monitoring of the business. To maximize the advantages of information technology, there is a much greater need to plan the organization's information architecture and information technology (IT) infrastructure.

4. *How has the Internet and Internet technology transformed business?* The Internet provides the primary technology infrastructure for electronic commerce, electronic business, and the emerging digital firm. The Internet and other networks have made it possible for businesses to replace manual and paper-based processes with electronic flows of information. In electronic commerce, businesses can exchange electronic purchase and sale transactions with each other and with individual customers. Electronic business uses the Internet and digital technology to expedite the exchange of information that can facilitate communication and coordination both inside the organization and between the organization and its business partners. Digital firms use Internet technology intensively for electronic commerce and electronic business to manage their internal processes and relationships with customers, suppliers, and other external entities.

5. *What are the major management challenges to building and using information systems?* There are five key management challenges in building and using information systems: (1) designing systems that are competitive and efficient; (2) understanding the system requirements of a global business environment; (3) creating an information architecture that supports the organization's goals; (4) determining the business value of information systems; and (5) designing systems that people can control, understand, and use in a socially and ethically responsible manner.

Key Terms

business functions
Specialized tasks performed in a business organization, including manufacturing and production, sales and marketing, finance, accounting, and human resources.

business processes
The unique ways in which organizations coordinate and organize work activities, information, and knowledge to produce a product or service.

communications technology
Physical devices and software that link various computer hardware components and transfer data from one physical location to another.

computer hardware
Physical equipment used for input, processing, and output activities in an information system.

computer literacy
Knowledge about information technology, focusing on understanding how computer-based technologies work.

computer software
Detailed, preprogrammed instructions that control and coordinate the work of computer hardware components in an information system.

computer-based information systems (CBIS)
Information systems that rely on computer hardware and software for processing and disseminating information.

data
Streams of raw facts representing events occurring in organizations or the physical environment before they have been organized and arranged into a form that people can understand and use.

data workers
People such as secretaries or bookkeepers who process the organization's paperwork.

digital firm
>Organization where nearly all significant business processes and relationships with customers, suppliers, and employees are digitally enabled, and key corporate assets are managed through digital means.

electronic business
>The use of Internet and other digital technology for organizational communication and coordination and the management of the firm.

electronic commerce
>The process of buying and selling goods and services electronically involving transactions using the Internet, networks, and other digital technologies.

electronic market
>A marketplace that is created by computer and communication technologies that link many buyers and sellers.

extranet
>Private intranet that is accessible to authorized outsiders.

feedback
>Output that is returned to the appropriate members of the organization to help them evaluate or correct input.

formal system
>System resting on accepted and fixed definitions of data and procedures, operating with predefined rules.

information
>Data that have been shaped into a form that is meaningful and useful to human beings.

information architecture
>The particular design that information technology takes in a specific organization to achieve selected goals or functions.

information system
>Interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and visualization in an organization.

information systems literacy
>Broad-based understanding of information systems that includes behavioral knowledge about organizations and individuals using information systems as well as technical knowledge about computers.

information technology (IT) infrastructure
>Computer hardware, software, data and storage technology, and networks providing a portfolio of shared information technology resources for the organization.

input
>The capture or collection of raw data from within the organization or from its external environment for processing in an information system.

Internet
>International network of networks that is a collection of hundreds of thousands of private and public networks.

interorganizational systems
> Information systems that automate the flow of information across organizational boundaries and link a company to its customers, distributors, or suppliers.

intranet
> An internal network based on Internet and World Wide Web technology and standards.

knowledge- and information-intense products
> Products that require a great deal of learning and knowledge to produce.

knowledge workers
> People such as engineers or architects who design products or services and create knowledge for the organization.

management information systems (MIS)
> The study of information systems focusing on their use in business and management.

mass customization
> The capacity to offer individually tailored products or services on a large scale.

middle managers
> People in the middle of the organizational hierarchy who are responsible for carrying out the plans and goals of senior management.

network
> The linking of two or more computers to share data or resources, such as a printer.

operational managers
> People who monitor the day-to-day activities of the organization.

output
> The distribution of processed information to the people who will use it or to the activities for which it will be used.

processing
> The conversion, manipulation, and analysis of raw input into a form that is more meaningful to humans.

production or service workers
> People who actually produce the products or services of the organization.

senior managers
> People occupying the topmost hierarchy in an organization who are responsible for making long-range decisions.

standard operating procedures (SOPs)
> Formal rules for accomplishing tasks that have been developed to cope with expected situations.

storage technology
> Physical media and software governing the storage and organization of data for use in an information system.

Web site
> All of the World Wide Web pages maintained by an organization or an individual.

World Wide Web
     A system with universally accepted standards for storing, retrieving, formatting, and displaying information in a networked environment.

Review Questions

1. Why are information systems essential in business today? Describe four trends in the global business environment that have made information systems so important.

2. Describe the capabilities of a digital firm. Why are digital firms so powerful?

3. What is an information system? Distinguish between a computer, a computer program, and an information system. What is the difference between data and information?

4. What activities convert raw data to usable information in information systems? What is their relationship to feedback?

5. What is information systems literacy? How does it differ from computer literacy?

6. What are the organization, management, and technology dimensions of information systems?

7. Distinguish between a behavioral and a technical approach to information systems in terms of the questions asked and the answers provided. What major disciplines contribute to an understanding of information systems?

8. What is the relationship between an organization and its information systems? How has this relationship changed over time?

9. What are the Internet and the World Wide Web? How have they changed the role played by information systems in organizations?

10. Describe some of the major changes that information systems are bringing to organizations.

11. How are information systems changing the management process?

12. What is the relationship between the network revolution, the digital firm, electronic commerce, and electronic business?

13. What are interorganizational systems? Why are they becoming more important? How has Internet and Web technology affected these systems?

14. What do we mean by information architecture and information technology infrastructure? Why are they important concerns for managers?

15. What are the key management challenges involved in building, operating, and maintaining information systems today?

Chapter 2:
Information Systems in the Enterprise

2.1 Key System Applications in the Organization

Different Kinds of Systems

Six Major Types of Systems

Relationship of Systems to One Another

2.2 Systems from a Functional Perspective

Sales and Marketing Systems

Manufacturing and Production Systems

Finance and Accounting Systems

Human Resources Systems

2.3 Integrating Functions and Business Processes: Customer Relationship Management, Supply Chain Management, Collaborative Commerce, and Enterprise Systems

Business Processes and Information Systems

Customer Relationship Management and Supply Chain Management

Collaborative Commerce and Industrial Networks

Enterprise Systems

2.4 International Information Systems

Forms of Global Business Organization

Global System Configuration

Management Wrap-Up

Summary

Key Terms

Review Questions

Case Study

Management Challenges

Businesses need different types of information systems to support decision making and work activities for various organizational levels and functions. Many may need systems that integrate information and business processes from different functional areas. Flextronics, for instance, needed information systems that would allow it to precisely coordinate its supply chain. It found a solution in using the same enterprise system in all of its locations for important business processes for sales, production, and logistics. The opening vignette presents the potential rewards to firms with well-conceived systems linking the entire enterprise. Such systems typically require a significant amount of organizational and management change and raise the following management challenges:

1. **Integration.** Although it is necessary to design different systems serving different levels and functions in the firm, more and more firms are finding advantages in integrating systems. However, integrating systems for different organizational levels and functions to freely exchange information can be technologically difficult and costly. Managers need to determine what level of system integration is required and how much it is worth in dollars.

2. **Enlarging the scope of management thinking.** Most managers are trained to manage a product line, a division, or an office. They are rarely trained to optimize the performance of the organization as a whole and often are not given the means to do so. But enterprise systems and industrial networks require managers to take a much larger view of their own behavior, including other products, divisions, departments, and even outside business firms. Investments in enterprise systems are huge, they must be developed over long periods of time, and they must be guided by a shared vision of the objectives.

In this chapter we examine the role of the various types of information systems in organizations. First, we look at ways of classifying information systems based on the organizational level they support. Next, we look at systems in terms of the organizational function they serve. We show how systems can support business processes for the major business functions and processes that span more than one function, such as supply chain management. We then examine enterprise systems and industrial networks, which enable organizations to integrate information and business processes across entire firms and even entire industries. Finally, we discuss different ways that information systems can be configured when businesses operate internationally.

> 2.1 Key System Applications in the Organization

Because there are different interests, specialties, and levels in an organization, there are different kinds of systems. No single system can provide all the information an organization needs. Figure 2-1 illustrates one way to depict the kinds of systems found in an organization. In the illustration, the organization is divided into strategic, management, knowledge, and operational levels and then is further divided into functional areas such as sales and marketing, manufacturing, finance, accounting, and human resources. Systems are built to serve these different organizational interests (Anthony, 1965).
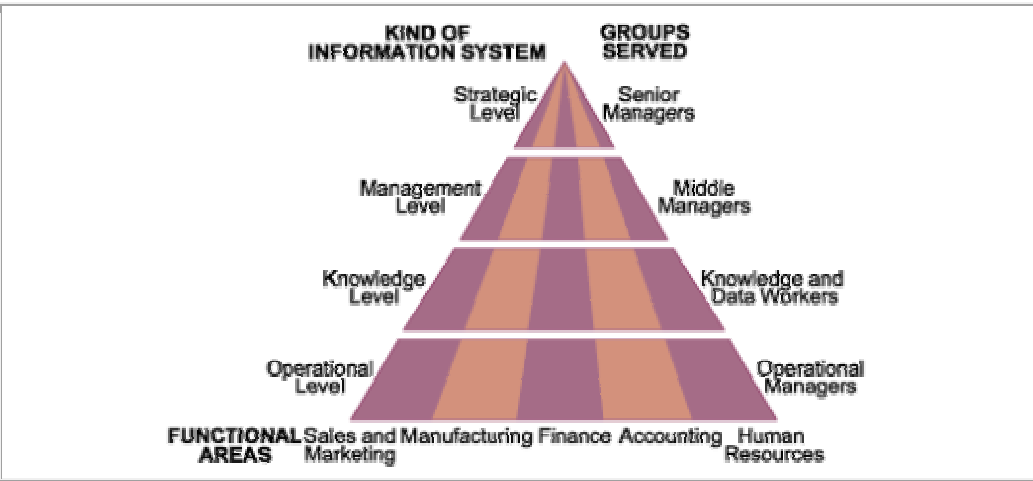
	Figure 2-1	Types of information systems

Organizations can be divided into strategic, management, knowledge, and operational levels and into five major functional areas: sales and marketing, manufacturing, finance, accounting, and human resources. Information systems serve each of these levels and functions.

Different Kinds of Systems

Four main types of information systems serve different organizational levels: operational-level systems, knowledge-level systems, management-level systems, and strategic-level systems. Operational-level systems support operational managers by keeping track of the elementary activities and transactions of the organization, such as sales, receipts, cash deposits, payroll, credit decisions, and the flow of materials in a factory. The principal purpose of systems at this level is to answer routine questions and to track the flow of transactions through the organization. How many parts are in inventory? What happened to Mr. Williams's payment? To answer these kinds of questions, information generally must be easily available, current, and accurate. Examples of operational-level systems include a system to record bank deposits from automatic teller machines or one that tracks the number of hours worked each day by employees on a factory floor.

Knowledge-level systems support the organization's knowledge and data workers. The purpose of knowledge-level systems is to help the business firm integrate new knowledge into the business and to help the organization control the flow of paperwork. Knowledge-level systems, especially in the form of workstations and office systems, are among the fastest-growing applications in business today.

Management-level systems serve the monitoring, controlling, decision-making, and administrative activities of middle managers. The principal question addressed by such systems is, Are things working well? Management-level systems typically provide periodic reports rather than instant information on operations. An example is a relocation control system that reports on the total moving, house-hunting, and home financing costs for employees in all company divisions, noting wherever actual costs exceed budgets.

Some management-level systems support nonroutine decision making (Keen and Morton, 1978). They tend to focus on less-structured decisions for which information requirements are not always clear. These systems often answer "what-if" questions: What would be the impact on production schedules if we were to double sales in the month of December? What would happen to our return on investment if a factory schedule were delayed for six months? Answers to these questions frequently require new data from outside the organization, as well as data from inside that cannot be easily drawn from existing operational-level systems.

Strategic-level systems help senior management tackle and address strategic issues and long-term trends, both in the firm and in the external environment. Their principal concern is matching changes in the external environment with existing organizational capability. What will employment levels be in five years? What

are the long-term industry cost trends, and where does our firm fit in? What products should we be making in five years?

Information systems also serve the major business functions, such as sales and marketing, manufacturing, finance, accounting, and human resources. A typical organization has operational-, management-, knowledge-, and strategic-level systems for each functional area. For example, the sales function generally has a sales system on the operational level to record daily sales figures and to process orders. A knowledge-level system designs promotional displays for the firm's products. A management-level system tracks monthly sales figures by sales territory and reports on territories where sales exceed or fall below anticipated levels. A system to forecast sales trends over a five-year period serves the strategic level. We first describe the specific categories of systems serving each organizational level and their value to the organization. Then we show how organizations use these systems for each major business function.

Six Major Types of Systems

Figure 2-2 shows the specific types of information systems that correspond to each organizational level. The organization has executive support systems (ESS) at the strategic level; management information systems (MIS) and decision-support systems (DSS) at the management level; knowledge work systems (KWS) and office systems at the knowledge level; and transaction processing systems (TPS) at the operational level. Systems at each level in turn are specialized to serve each of the major functional areas. Thus, the typical systems found in organizations are designed to assist workers or managers at each level and in the functions of sales and marketing, manufacturing, finance, accounting, and human resources.

| Figure 2-2 | The six major types of information systems |

This figure provides examples of TPS, office systems, KWS, DSS, MIS, and ESS, showing the level of the organization and business function that each supports.

Table 2-1 summarizes the features of the six types of information systems. It should be noted that each of the different systems may have components that are used by organizational levels and groups other than their main constituencies. A secretary may find information on an MIS, or a middle manager may need to extract data from a TPS.

Table 2-1	Characteristics of Information Processing Systems			
Type of System	**Information Inputs**	**Processing**	**Information Outputs**	**Users**
ESS	Aggregate data; external, internal	Graphics; simulations; interactive	Projections; responses to queries	Senior managers
DSS	Low-volume data or massive databases optimized for data analysis; analytic models and data analysis tools	Interactive; simulations; analysis	Special reports; decision analyses; responses to queries	Professionals; technical staff
MIS	Summary transaction data; high-volume data; simple models	Routine reports; simple models; low-level analysis	Summary and exception reports	Middle managers
KWS	Design specifications; knowledge base	Modeling; simulations	Models; graphics	Professionals; technical staff
Office systems	Documents; schedules	Document management; scheduling; communication	Documents; schedules; mail	Clerical workers
TPS	Transactions; events	Sorting; listing; merging; updating	Detailed reports; lists; summaries	Operations personnel; supervisors

Transaction Processing Systems

Transaction processing systems (TPS) are the basic business systems that serve the operational level of the organization. A transaction processing system is a computerized system that performs and records the daily routine transactions necessary to the conduct of the business. Examples are sales order entry, hotel reservation systems, payroll, employee record keeping, and shipping.

At the operational level, tasks, resources, and goals are predefined and highly structured. The decision to grant credit to a customer, for instance, is made by a lower-level supervisor according to predefined criteria. All that must be determined is whether the customer meets the criteria.

Figure 2-3 depicts a payroll TPS, which is a typical accounting transaction processing system found in most firms. A payroll system keeps track of the money paid to employees. The master file is composed of discrete pieces of information (such as a name, address, or employee number) called data elements. Data are keyed into the system, updating the data elements. The elements on the master file are combined in different ways to make up reports of interest to management and government agencies and to send paychecks to employees. These TPS can generate other report combinations of existing data elements.
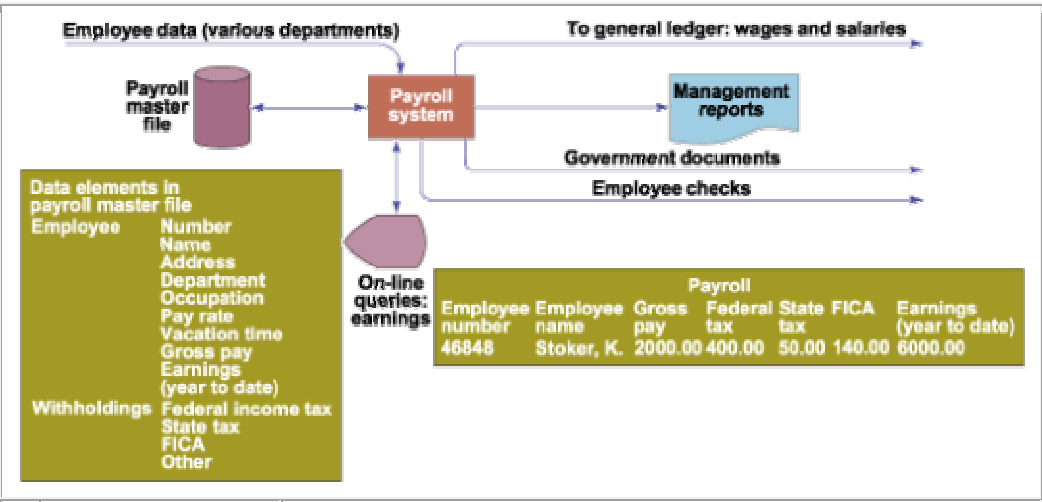
| Figure 2-3 | A symbolic representation for a payroll TPS |

Other typical TPS applications are identified in Figure 2-4. The figure shows that there are five functional categories of TPS: sales/marketing, manufacturing/production, finance/ accounting, human resources, and other types of TPS that are unique to a particular industry. The UPS package tracking system described in Chapter 1 is an example of a manufacturing TPS. UPS sells package delivery services; the system keeps track of all of its package shipment transactions.

| Figure 2-4 | Typical applications of TPS |

There are five functional categories of TPS: sales/marketing, manufacturing/production, finance/accounting, human resources, and other types of systems specific to a particular industry. Within each of these major functions are subfunctions. For each of these subfunctions (e.g., sales management) there is a major application system.

Transaction processing systems are often so central to a business that TPS failure for a few hours can spell a firm's demise and perhaps harm other firms linked to it. Imagine what would happen to UPS if its package tracking system were not working! What would the airlines do without their computerized reservation systems?

Managers need TPS to monitor the status of internal operations and the firm's relations with the external environment. TPS are also major producers of information for the other types of systems. (For example, the payroll system illustrated here, along with other accounting TPS, supplies data to the company's general ledger system, which is responsible for maintaining records of the firm's income and expenses and for producing reports such as income statements and balance sheets.)

Knowledge Work and Office Systems

Knowledge work systems (KWS) and office systems serve the information needs at the knowledge level of the organization. Knowledge work systems aid knowledge workers, whereas office systems primarily aid data workers (although they are also used extensively by knowledge workers).

In general, *knowledge workers* are people who hold formal university degrees and who are often members of recognized professions, such as engineers, doctors, lawyers, and scientists. Their jobs consist primarily of creating new information and knowledge. KWS, such as scientific or engineering design workstations, promote the creation of new knowledge and ensure that new knowledge and technical expertise are properly integrated into the business. *Data workers* typically have less formal, advanced educational degrees and tend to process rather than create information. They consist primarily of secretaries, bookkeepers, filing clerks, or managers whose jobs are principally to use, manipulate, or disseminate information. Office systems are information technology applications designed to increase data workers' productivity by supporting the coordinating and communicating activities of the typical office. Office systems coordinate diverse information workers, geographic units, and functional areas: The systems communicate with customers, suppliers, and other organizations outside the firm and serve as clearinghouses for information and knowledge flows.

Typical office systems handle and manage documents (through word processing, desktop publishing, document imaging, and digital filing), scheduling (through electronic calendars), and communication (through electronic mail, voice mail, or videoconferencing). Word processing refers to the software and hardware that creates, edits, formats, stores, and prints documents (see Chapter 6). Word processing systems represent the single most common application of information technology to office work, in part because producing documents is what offices are all about. Desktop publishing produces professional publishing-quality documents by combining output from word processing software with design elements, graphics, and special layout features. Companies are now starting to publish documents in the form of Web pages for easier access and distribution. We describe Web publishing in more detail in Chapter 10.

Document imaging systems are another widely used knowledge application. Document imaging systems convert documents and images into digital form so that they can be stored and accessed by the computer.

Management Information Systems

In Chapter 1, we defined management information systems as the study of information systems in business and management. The term *management information systems (MIS)* also designates a specific category of information systems serving management-level functions. Management information systems (MIS) serve the management level of the organization, providing managers with reports or with on-line access to the organization's current performance and historical records. Typically, they are oriented almost exclusively to internal, not environmental or external, events. MIS primarily serve the functions of planning, controlling, and decision making at the management level. Generally, they depend on underlying transaction processing systems for their data.

MIS summarize and report on the company's basic operations. The basic transaction data from TPS are compressed and are usually presented in long reports that are produced on a regular schedule. Figure 2-5 shows how a typical MIS transforms transaction level data from inventory, production, and accounting into MIS files that are used to provide managers with reports. Figure 2-6 shows a sample report from this system.
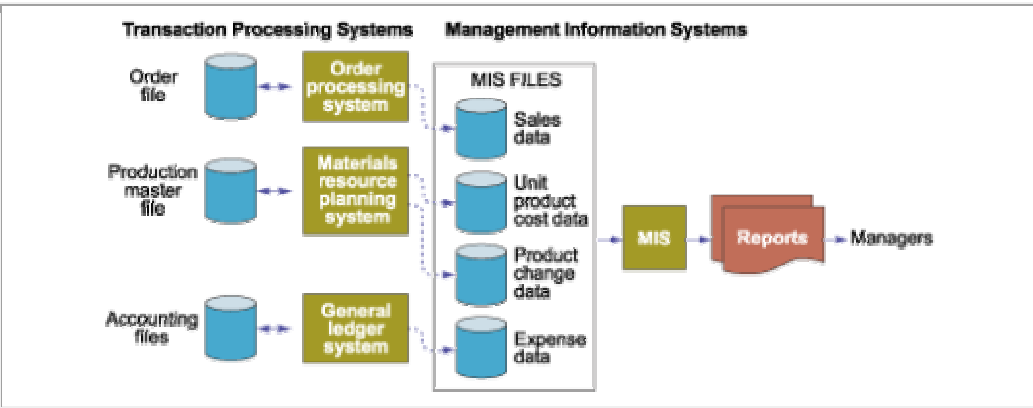
Figure 2-5	How management information systems obtain their data from the organization's TPS

In the system illustrated by this diagram, three TPS supply summarized transaction data at the end of the time period to the MIS reporting system. Managers gain access to the organizational data through the MIS, which provides them with the appropriate reports.

Figure 2-6	A sample report that might be produced by the MIS in Figure 2-5.

Consolidated Consumer Products Corporation Sales by Product and Sales Region: 2002

MIS usually serve managers interested in weekly, monthly, and yearly results—not day-to-day activities. MIS generally provide answers to routine questions that have been specified in advance and have a predefined procedure for answering them. For instance, MIS reports might list the total pounds of lettuce used this quarter by a fast-food chain or, as illustrated in Figure 2-6, compare total annual sales figures for specific products to planned targets. These systems are generally not flexible and have little analytical capability. Most MIS use simple routines such as summaries and comparisons, as opposed to sophisticated mathematical models or statistical techniques.

Decision-Support Systems

Decision-support systems (DSS) also serve the management level of the organization. DSS help managers make decisions that are unique, rapidly changing, and not easily specified in advance. They address problems where the procedure for arriving at a solution may not be fully predefined in advance. Although DSS use internal information from TPS and MIS, they often bring in information from external sources, such as current stock prices or product prices of competitors.

Clearly, by design, DSS have more analytical power than other systems. They are built explicitly with a variety of models to analyze data, or they condense large amounts of data into a form in which they can be

analyzed by decision makers. DSS are designed so that users can work with them directly; these systems explicitly include user-friendly software. DSS are interactive; the user can change assumptions, ask new questions, and include new data.

An interesting, small, but powerful DSS is the voyage-estimating system of a subsidiary of a large American metals company that exists primarily to carry bulk cargoes of coal, oil, ores, and finished products for its parent company. The firm owns some vessels, charters others, and bids for shipping contracts in the open market to carry general cargo. A voyage-estimating system calculates financial and technical voyage details. Financial calculations include ship/time costs (fuel, labor, capital), freight rates for various types of cargo, and port expenses. Technical details include a myriad of factors such as ship cargo capacity, speed, port distances, fuel and water consumption, and loading patterns (location of cargo for different ports). The system can answer questions such as the following: Given a customer delivery schedule and an offered freight rate, which vessel should be assigned at what rate to maximize profits? What is the optimum speed at which a particular vessel can optimize its profit and still meet its delivery schedule? What is the optimal loading pattern for a ship bound for the U.S. west coast from Malaysia? Figure 2-7 illustrates the DSS built for this company. The system operates on a powerful desktop personal computer, providing a system of menus that makes it easy for users to enter data or obtain information. We describe other types of DSS in Chapter 11.
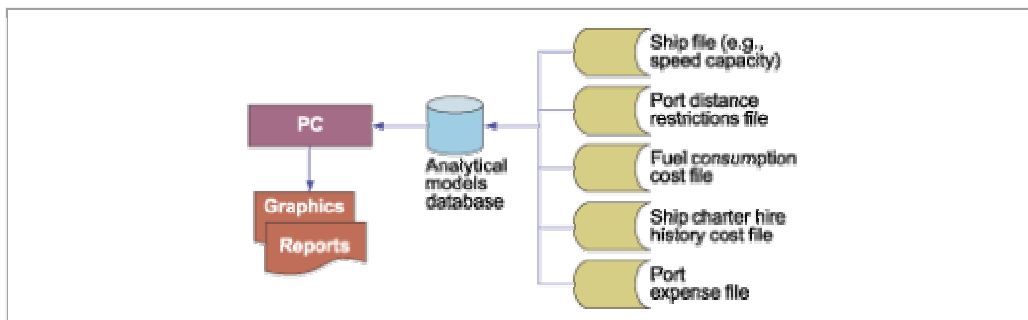

	Figure 2-7	Voyage-estimating decision-support system

This DSS operates on a powerful PC. It is used daily by managers who must develop bids on shipping contracts.

Executive Support Systems

Senior managers use executive support systems (ESS) to make decisions. ESS serve the strategic level of the organization. They address nonroutine decisions requiring judgment, evaluation, and insight because there is no agreed-on procedure for arriving at a solution. ESS create a generalized computing and communications environment rather than providing any fixed application or specific capability. ESS are designed to incorporate data about external events such as new tax laws or competitors, but they also draw summarized information from internal MIS and DSS. They filter, compress, and track critical data, emphasizing the reduction of time and effort required to obtain information useful to executives. ESS employ the most advanced graphics software and can deliver graphs and data from many sources immediately to a senior executive's office or to a boardroom.

Unlike the other types of information systems, ESS are not designed primarily to solve specific problems. Instead, ESS provide a generalized computing and communications capacity that can be applied to a changing array of problems. Although many DSS are designed to be highly analytical, ESS tend to make less use of analytical models.

Questions ESS assist in answering include the following: What business should we be in? What are the competitors doing? What new acquisitions would protect us from cyclical business swings? Which units should we sell to raise cash for acquisitions (Rockart and Treacy, 1982)? Figure 2-8 illustrates a model of an ESS. It consists of workstations with menus, interactive graphics, and communications capabilities that can access historical and competitive data from internal corporate systems and external databases such as Dow

Jones News/Retrieval or the Gallup Poll. Because ESS are designed to be used by senior managers who often have little, if any, direct contact or experience with computer-based information systems, they incorporate easy-to-use graphic interfaces. More details on leading-edge applications of DSS and ESS can be found in Chapter 11.
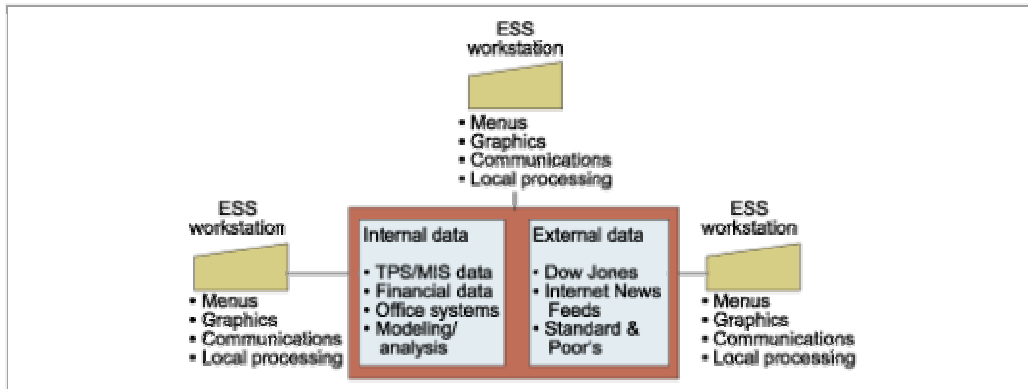
| Figure 2-8 | Model of a typical executive support system |

This system pools data from diverse internal and external sources and makes them available to executives in an easy-to-use form.

Relationship of Systems to One Another

Figure 2-9 illustrates how the systems serving different levels in the organization are related to one another. TPS are typically a major source of data for other systems, whereas ESS are primarily a recipient of data from lower-level systems. The other types of systems may exchange data with each other as well. Data may also be exchanged among systems serving different functional areas. For example, an order captured by a sales system may be transmitted to a manufacturing system as a transaction for producing or delivering the product specified in the order.

| Figure 2-9 | Interrelationships among systems |

The various types of systems in the organization have interdependencies. TPS are major producers of information that is required by the other systems, which, in turn, produce information for other systems. These different types of systems are only loosely coupled in most organizations.

It is definitely advantageous to have some measure of integration among these systems so that information can flow easily between different parts of the organization. But integration costs money, and integrating many differe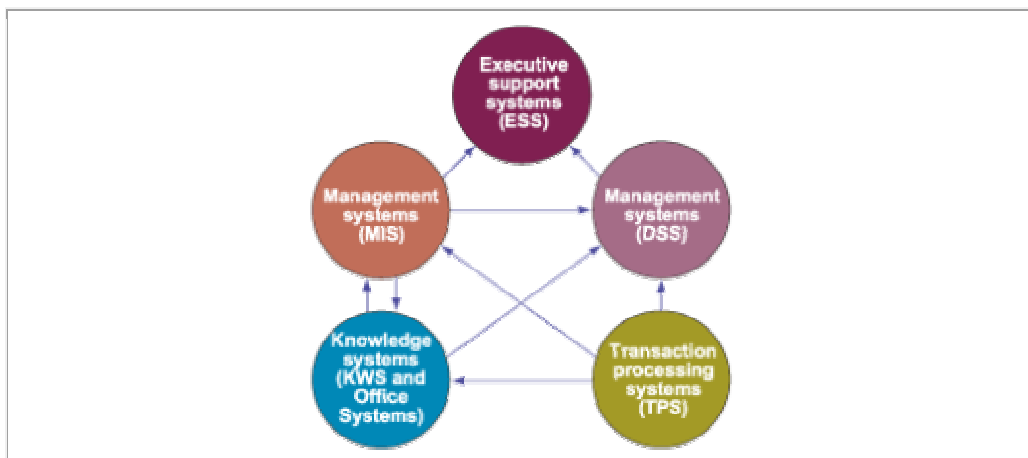nt systems is extremely time consuming and complex. Each organization must weigh its needs for integrating systems against the difficulties of mounting a large-scale systems integration effort. The discussion of enterprise systems in Section 2.3 treats this issue in greater detail.

> 2.2 Systems from a Functional Perspective

Information systems can be classified by the specific organizational function they serve as well as by organizational level. We now describe typical information systems that support each of the major business functions and provide examples of functional applications for each organizational level.

Sales and Marketing Systems

The sales and marketing function is responsible for selling the organization's product or service. Marketing is concerned with identifying the customers for the firm's products or services, determining what they need or want, planning and developing products and services to meet their needs, and advertising and promoting these products and services. Sales is concerned with contacting customers, selling the products and services, taking orders, and following up on sales. Sales and marketing information systems support these activities.

Table 2-2 shows that information systems are used in sales and marketing in a number of ways. At the strategic level, sales and marketing systems monitor trends affecting new products and sales opportunities, support planning for new products and services, and monitor the performance of competitors. At the management level, sales and marketing systems support market research, advertising and promotional campaigns, and pricing decisions. They analyze sales performance and the performance of the sales staff. Knowledge-level sales and marketing systems support marketing analysis workstations. At the operational level, sales and marketing systems assist in locating and contacting prospective customers, tracking sales, processing orders, and providing customer service support.

Table 2-2	Examples of Sales and Marketing Information Systems	
System	**Description**	**Organizational Level**
Order processing	Enter, process, and track orders	Operational
Market analysis	Identify customers and markets using data on demographics, markets, consumer behavior, and trends	Knowledge
Pricing analysis	Determine prices for products and services	Management
Sales trend forecasting	Prepare 5-year sales forecasts	Strategic

Review Figure 2-6. It shows the output of a typical sales information system at the management level. The system consolidates data about each item sold (such as the product code, product description, and sales amount) for further management analysis. Company managers examine these sales data to monitor sales activity and buying trends. The Window on Management describes the business benefits of another sales and marketing system.

Manufacturing and Production Systems

The manufacturing and production function is responsible for actually producing the firm's goods and services. Manufacturing and production systems deal with the planning, development, and maintenance of production facilities; the establishment of production goals; the acquisition, storage, and availability of production materials; and the scheduling of equipment, facilities, materials, and labor required to fashion finished products. Manufacturing and production information systems support these activities.

Table 2-3 shows some typical manufacturing and production information systems arranged by organizational level. Strategic-level manufacturing systems deal with the firm's long-term manufacturing goals, such as where to locate new plants or whether to invest in new manufacturing technology. At the management level, manufacturing and production systems analyze and monitor manufacturing and production costs and resources. Knowledge manufacturing and production systems create and distribute design knowledge or expertise to drive the production process, and operational manufacturing and production systems deal with the status of production tasks.

Table 2-3	Examples of Manufacturing and Production Information Systems	
System	**Description**	**Organizational Level**
Machine control	Control the actions of machines and equipment	Operational
Computer-aided design (CAD)	Design new products using the computer	Knowledge
Production planning	Decide when and how many products should be produced	Management
Facilities location	Decide where to locate new production facilities	Strategic

Most manufacturing and production systems use some sort of inventory system, as illustrated in Figure 2-10. Data about each item in inventory, such as the number of units depleted because of a shipment or purchase or the number of units replenished by reordering or returns, are either scanned or keyed into the system. The inventory master file contains basic data about each item, including the unique identification code for each item, the description of the item, the number of units on hand, the number of units on order, and the reorder point (the number of units in inventory that triggers a decision to reorder to prevent a stockout). Companies can estimate the number of items to reorder or they can use a formula for calculating the least expensive quantity to reorder called the *economic order quantity*. The system produces reports such as the number of each item available in inventory, the number of units of each item to reorder, or items in inventory that must be replenished.
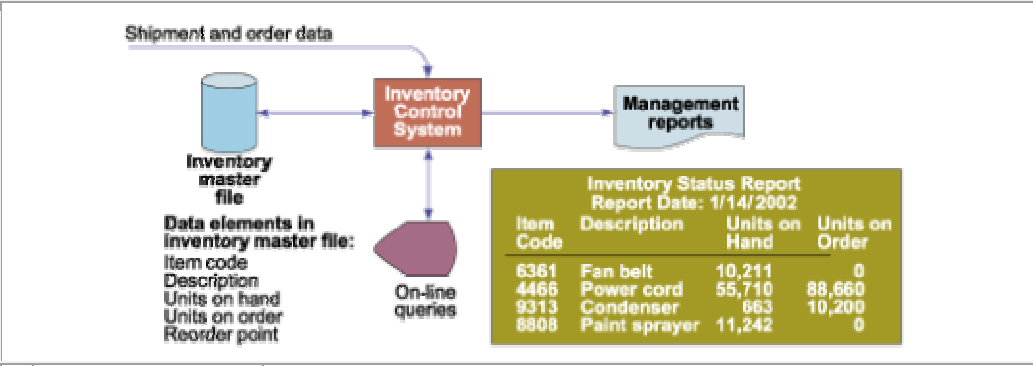
	Figure 2-10	Overview of an inventory system

This system provides information about the number of items available in inventory to support manufacturing and production activities.

http://gmx.xmu.edu.cn/ews/business/emis/chapter02.htm - top

Finance and Accounting Systems

The finance function is responsible for managing the firm's financial assets, such as cash, stocks, bonds, and other investments in order to maximize the return on these financial assets. The finance function is also in charge of managing the capitalization of the firm (finding new financial assets in stocks, bonds, or other forms of debt). In order to determine whether the firm is getting the best return on its investments, the finance function must obtain a considerable amount of information from sources external to the firm.

The accounting function is responsible for maintaining and managing the firm's financial records—receipts, disbursements, depreciation, payroll—to account for the flow of funds in a firm. Finance and accounting share related problems—how to keep track of a firm's financial assets and fund flows. They provide answers to questions such as these: What is the current inventory of financial assets? What records exist for disbursements, receipts, payroll, and other fund flows?

Table 2-4 shows some of the typical finance and accounting information systems found in large organizations. Strategic-level systems for the finance and accounting function establish long-term investment goals for the firm and provide long-range forecasts of the firm's financial performance. At the management level, information systems help managers oversee and control the firm's financial resources. Knowledge systems support finance and accounting by providing analytical tools and workstations for designing the right mix of investments to maximize returns for the firm. Operational systems in finance and accounting track the flow of funds in the firm through transactions such as paychecks, payments to vendors, securities reports, and receipts.

Table 2-4	Examples of Finance and Accounting Information Systems	
System	**Description**	**Organizational Level**
Accounts receivable	Track money owed the firm	Operational
Portfolio analysis	Design the firm's portfolio of investments	Knowledge
Budgeting	Prepare short-term budgets	Management
Profit planning	Plan long-term profits	Strategic

Review Figure 2-3, which illustrates a payroll system, a typical accounting TPS found in all businesses with employees.

http://gmx.xmu.edu.cn/ews/business/emis/chapter02.htm - top **Human Resources Systems**

The human resources function is responsible for attracting, developing, and maintaining the firm's work force. Human resources information systems support activities such as identifying potential employees, maintaining complete records on existing employees, and creating programs to develop employees' talents and skills.

Strategic-level human resources systems identify the manpower requirements (skills, educational level, types of positions, number of positions, and cost) for meeting the firm's long-term business plans. At the management level, human resources systems help managers monitor and analyze the recruitment, allocation, and compensation of employees. Knowledge systems for human resources support analysis activities related to job design, training, and the modeling of employee career paths and reporting relationships. Human resources operational systems track the recruitment and placement of the firm's employees (see Table 2-5).

Table 2-5	Examples of Human Resources Information Systems	
System	**Description**	**Organizational Level**
Training and development	Track employee training, skills, and performance appraisals	Operational
Career pathing	Design career paths for employees	Knowledge
Compensation analysis	Monitor the range and distribution of employee wages, salaries, and benefits	Management
Human resources planning	Plan the long-term labor force needs of the organization	Strategic

Figure 2-11 illustrates a typical human resources TPS for employee record keeping. It maintains basic employee data, such as the employee's name, age, sex, marital status, address, educational background, salary, job title, date of hire, and date of termination. The system can produce a variety of reports, such as lists of newly hired employees, employees who are terminated or on leaves of absence, employees classified by job type or educational level, or employee job performance evaluations. Such systems are typically designed to provide data that can satisfy federal and state record keeping requirements for Equal Employment Opportunity (EEO) and other purposes.
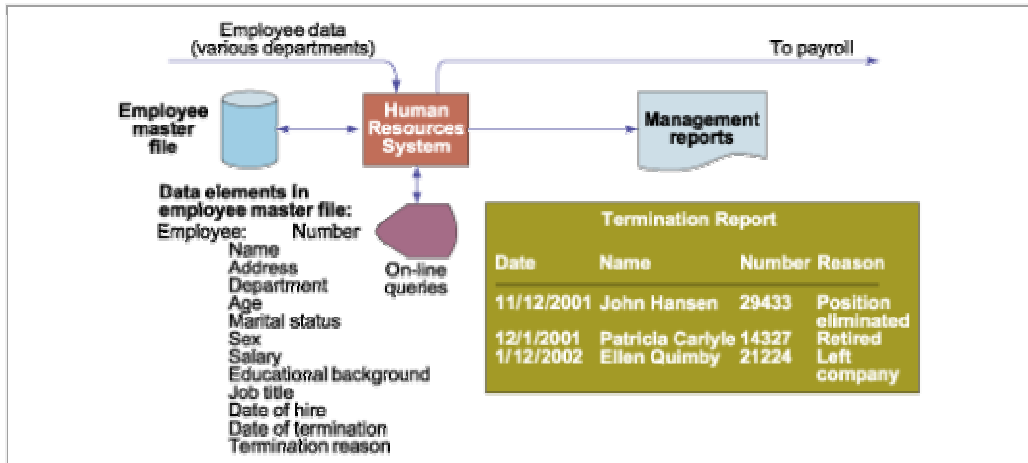

| Figure 2-11 | An employee record keeping system |

This system maintains data on the firm's employees to support the human resources function.

> 2.3 Integrating Functions and Business Processes: Customer Relationship Management, Supply Chain Management, Collaborative Commerce, and Enterprise Systems

Organizations are using information systems to coordinate activities and decisions across entire firms and even entire industries. Information systems for customer relationship management (CRM) and supply chain management (SCM) can help coordinate processes that span multiple business functions, including those shared with customers and other supply chain partners. Enterprise systems can automate the flow of information across business processes throughout the entire organization.

Business Processes and Information Systems

The systems we have just described support flows of work and activities called business processes. Business processes refer to the manner in which work is organized, coordinated, and focused to produce a valuable product or service. On the one hand, business processes are concrete work flows of material, information, and knowledge—sets of activities. Business processes also refer to the unique ways in which organizations coordinate work, information, and knowledge, and the ways in which management chooses to coordinate work. Table 2-6 describes typical business processes for each of the functional areas.

Table 2-6	Examples of Business Processes
Functional Area	**Business Process**
Manufacturing and production	Assembling the product Checking for quality Producing bills of materials
Sales and marketing	Identifying customers Making customers aware of the product Selling the product
Finance and accounting	Paying creditors Creating financial statements Managing cash accounts
Human resources	Hiring employees Evaluating employees' job performance Enrolling employees in benefits plans

Although each of the major business functions has its own set of business processes, many other business processes are cross-functional, transcending the boundaries between sales, marketing, manufacturing, and research and development. These cross-functional processes cut across the traditional organizational structure, grouping employees from different functional specialties to complete a piece of work. For example, the order fulfillment process at many companies requires cooperation among the sales function (receiving the order, entering the order), the accounting function (credit checking and billing for the order), and the manufacturing function (assembling and shipping the order). Figure 2-12 illustrates how this cross-functional process might work. Information systems support these cross-functional processes as well as processes for the separate business functions.
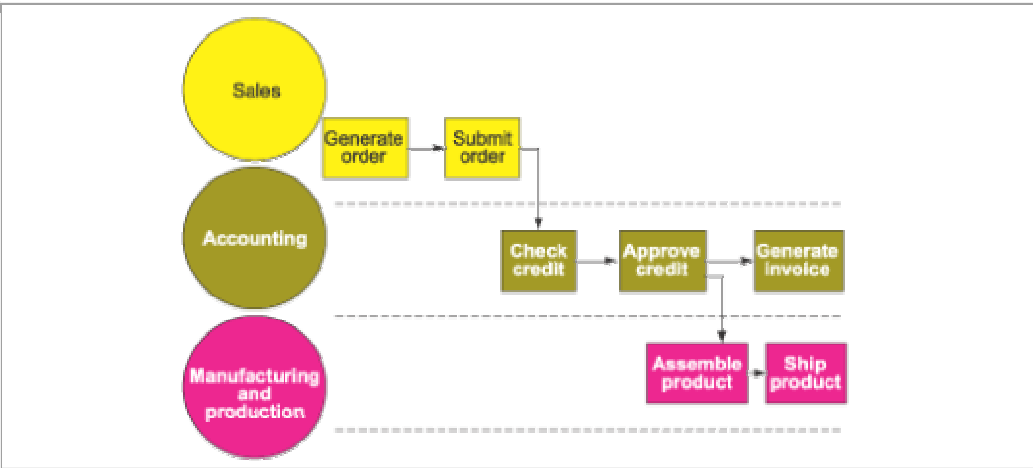
Figure 2-12	The order fulfillment process

Generating and fulfilling an order is a multi-step process involving activities performed by the sales, manufacturing and production, and accounting functions.

Information systems can help organizations achieve great efficiencies by automating parts of these processes or by helping organizations rethink and streamline these processes. However, redesigning business processes requires careful analysis and planning. When systems are used to strengthen the wrong business model or

business processes, the business can become more efficient at doing what it should not do. As a result, the firm becomes vulnerable to competitors who may have discovered the right business model. Therefore, one of the most important strategic decisions that a firm can make is not deciding how to use computers to improve business processes, but instead to first understand what business processes need improvement (Keen, 1997). Chapter 12 treats this subject in greater detail, because it is fundamental to systems analysis and design.

[http://gmx.xmu.edu.cn/ews/business/emis/chapter02.htm - top](http://gmx.xmu.edu.cn/ews/business/emis/chapter02.htm) **Customer Relationship Management and Supply Chain Management**

Electronic commerce, global competition, and the rise of digital firms have made companies think strategically about their business processes for managing their relationships with customers and suppliers. Consumers can now use the Web to comparison shop and switch companies on a moment's notice. To survive, businesses need to find ways of providing more value and service to customers at lower cost. Many believe the solution lies in improving business processes for interacting with customers and for producing and delivering products or services.

Customer Relationship Management (CRM)

Instead of treating customers as exploitable sources of income, businesses are now viewing them as long-term assets to be nurtured through customer relationship management. Customer relationship management (CRM) focuses on managing all of the ways that a firm deals with its existing and potential new customers. CRM is both a business and technology discipline that uses information systems to coordinate all of the business processes surrounding the firm's interactions with its customers in sales, marketing, and service. The ideal CRM system provides end-to-end customer care from receipt of an order through product delivery and service.

In the past, a firm's processes for sales, service, and marketing were highly compartmentalized and did not share much essential customer information. Some information on a specific customer might be stored and organized in terms of that person's account with the company. Other pieces of information about the same customer might be organized by products that were purchased. There was no way to consolidate all of this information to provide a unified view of a customer across the company. CRM tools try to solve this problem by integrating the firm's customer-related processes and consolidating customer information from multiple communication channels—telephone, e-mail, wireless devices, or the Web—so that the firm can present one coherent face to the customer (see Figure 2-13).

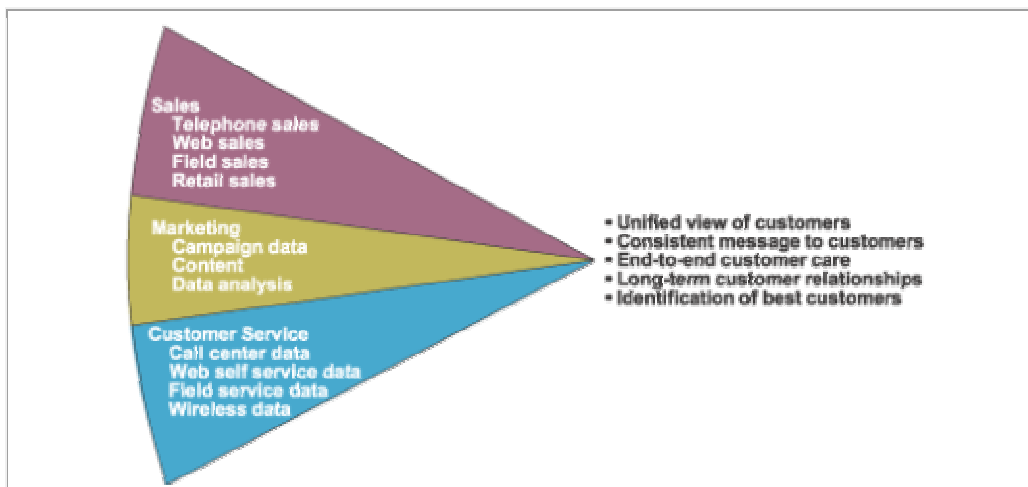|	Figure 2-13	Customer relationship management (CRM)

Customer relationship management applies technology to look at customers from a multifaceted perspective. CRM uses a set of integrated applications to address all aspects of

the customer relationship, including customer service, sales, and marketing.

Good CRM systems consolidate customer data from multiple sources and provide analytical tools for answering questions such as, What is the value of a particular customer to the firm over his or her lifetime? Who are our most loyal customers? (It costs six times more to sell to a new customer than to an existing customer [Kalakota and Robinson, 2001].) Who are our most profitable customers? (Typically 80 to 90 percent of a firm's profits are generated by 10 to 20 percent of its customers.) What do these profitable customers want to buy? Firms can then use the answers to acquire new customers, provide better service and support, customize their offerings more precisely to customer preferences, and provide ongoing value to retain profitable customers. Chapters 3, 4, 9, and 11 provide additional details on customer relationship management applications and technologies. The Window on Organizations shows how some European companies have benefited from customer relationship management.

Investing in CRM software alone won't automatically produce better information about customers, and many customer relationship management systems fall short of their objectives. These systems require changes in sales, marketing, and customer service processes
to encourage sharing of customer information; support from top management; and a very clear idea of the benefits that could be obtained from consolidating customer data (see Chapter 13). The Manager's Toolkit describes some of the customer data issues that managers must address.

Supply Chain Management

To deliver the product more rapidly to the customer and lower costs, companies are also trying to streamline their business processes for supply chain management. Supply chain management is the close linkage and coordination of activities involved in buying, making, and moving a product. It integrates supplier, manufacturer, distributor, and customer logistics processes to reduce time, redundant effort, and inventory costs. The supply chain is a network of organizations and business processes for procuring materials, transforming raw materials into intermediate and finished products, and distributing the finished products to customers. It links suppliers, manufacturing plants, distribution centers, conveyances, retail outlets, people, and information through processes such as procurement, inventory control, distribution, and delivery to supply goods and services from source through consumption. Materials, information, and payments flow through the supply chain in both directions. Goods start out as raw materials and move through logistics and production systems until they reach customers. The supply chain includes reverse logistics in which returned items flow in the reverse direction from the buyer back to the seller.

The supply chain illustrated in Figure 2-14 has been simplified. Most supply chains, especially those for large manufacturers such as automakers, are multitiered, with thousands of primary, secondary, and tertiary suppliers. To manage the supply chain, a company tries to eliminate redundant steps, delays, and the amount of resources tied up along the way.
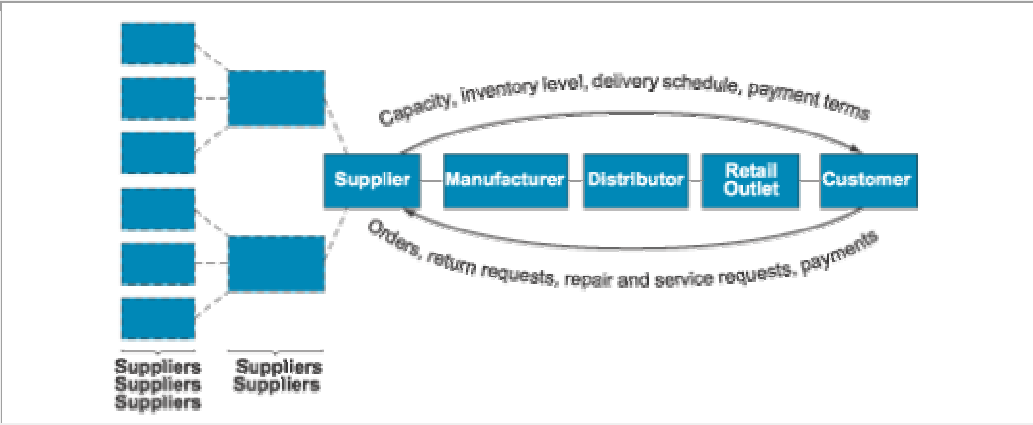
Figure 2-14	Supply chain management

This figure illustrates the major entities in the supply chain and the flow of information upstream and downstream to coordinate the activities involved in buying, making, and moving a product. Suppliers transform raw materials into intermediate products or components, and then manufacturers turn them into finished products. The products are shipped to distribution centers and from there to retailers and customers.

Companies that skillfully manage their supply chains get the right amount of their products from their source to their point of consumption with the least amount of time and the lowest cost. Information systems make supply chain management more efficient by helping companies coordinate, schedule, and control procurement, production, inventory management, and delivery of products and services. Supply chain management systems can be built using intranets, extranets, or special supply chain management software. Table 2-7 describes how companies can benefit from using information systems for supply chain management.

Table 2-7	How Information Systems Can Facilitate Supply Chain Management

Information Systems Can Help Participants in the Supply Chain

Decide when and what to produce, store, and move

Rapidly communicate orders

Track the status of orders

Check inventory availability and monitor inventory levels

Reduce inventory, transportation, and warehousing costs

Track shipments

Plan production based on actual customer demand

Rapidly communicate changes in product design

Inefficiencies in the supply chain, such as parts shortages, underutilized plant capacity, excessive finished goods inventory, or runaway transportation costs, are caused by inaccurate or untimely information. For example, manufacturers may keep too many parts in inventory because they don't know exactly when they will receive their next shipment from their suppliers. Suppliers may order too few raw materials because

they don't have precise information on demand. These supply chain inefficiencies can waste as much as 25 percent of a company's operating costs.

One recurring problem in supply chain management is the bullwhip effect, in which information about the demand for a product gets distorted as it passes from one entity to the next across the supply chain (Lee, Padmanabhan and Wang, 1997). A slight rise in demand for an item might cause different members in the supply chain—distributors, manufacturers, suppliers, suppliers' suppliers, and suppliers' suppliers' suppliers—to stockpile inventory so each has enough "just in case." These changes will ripple throughout the supply chain, magnifying what started out as a small change from planned orders, creating excess inventory, production, warehousing, and shipping costs. If all members of the supply chain could share dynamic information about inventory levels, schedules, forecasts, and shipments they would have a more precise idea of how to adjust their sourcing, manufacturing, and distribution plans.

Supply chain management uses systems for supply chain planning (SCP) and supply chain execution (SCE). *Supply chain planning systems* enable the firm to generate demand forecasts for a product and to develop sourcing and manufacturing plans for that product. *Supply chain execution systems* manage the flow of products through distribution centers and warehouses to ensure that products are delivered to the right locations in the most efficient manner. Table 2-8 provides more details on supply chain planning and execution systems.

Table 2-8	Supply Chain Planning and Execution Systems Capabilities of Supply Chain Planning Systems

Order planning: Select an order fulfillment plan that best meets the desired level of service to the customer given existing transportation and manufacturing constraints.

Advanced scheduling and manufacturing planning: Provide detailed coordination of scheduling based on analysis of changing factors such as customer orders, equipment outages, or supply interruptions. Scheduling modules create job schedules for the manufacturing process and supplier logistics.

Demand planning: Generate demand forecasts from all business units using statistical tools and business forecasting techniques.

Distribution planning: Create operating plans for logistics managers for order fulfillment, based on input from demand and manufacturing planning modules.

Transportation planning: Track and analyze inbound and outbound movement of materials and products to ensure that materials and finished goods are delivered at the right time and place at the minimum cost.

Capabilities of Supply Chain Execution Systems

Order planning: Select an order fulfillment plan that best meets the desired level of service to the customer given existing transportation and manufacturing constraints

Final Production: Organize and schedule final subassemblies required to make each final product.

Replenishment: Coordinate component replenishment work so that warehouses remain stocked with the minimum amount of inventory in the pipeline.

Distribution management: Coordinate the process of transporting goods from the manufacturer to distribution centers to the final customer. Provide on-line customer access to shipment and delivery data.

Reverse distribution: Track the shipment and accounting for returned goods or remanufactured products.

Collaborative Commerce and Industrial Networks

Successful supply chain management requires an atmosphere of trust where all the members of the supply chain agree to cooperate and to honor the commitments they have made to each other (Welty and Becerra-Fernandez, 2001). They must be able to work together on the same goal and to redesign some of their business processes so that they can coordinate their activities more easily. In some industries, companies have extended their supply chain management systems to work more collaboratively with customers, suppliers, and other firms in their industry. This is a much broader mission than traditional supply chain management systems, which focused primarily on managing the flow of transactions among organizations. It focuses on using shared systems and business processes to optimize the value of relationships.

Companies are relying on these new collaborative relationships to further improve their planning, production, and distribution of goods and services. The use of digital technologies to enable multiple organizations to collaboratively design, develop, build, move, and manage products through their lifecycles is called collaborative commerce. Firms can integrate their systems with those of their supply chain partners to coordinate demand forecasting, resource planning, production planning, replenishment, shipping, and warehousing. They can work jointly with suppliers on product design and marketing. Customers can provide feedback for marketers to use to improve product design, support, and service. A firm engaged in collaborative commerce with its suppliers and customers can achieve new levels of efficiency in reducing product design cycles, minimizing excess inventory, forecasting demand, and keeping partners and customers informed (see Figure 2-15).
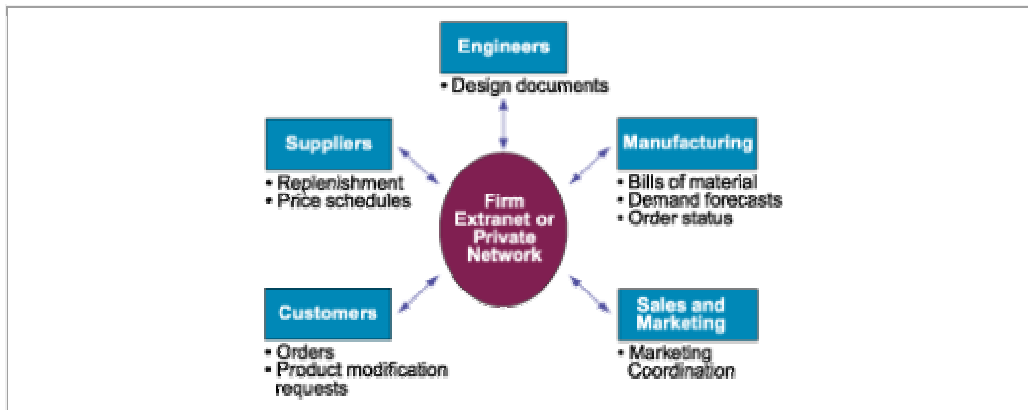

Figure 2-15	Collaborative commerce

Collaborative commerce is a set of digitally enabled collaborative interactions between an enterprise and its business partners and customers. Data and processes that were once considered internal can be shared by the collaborative community.

For example, Briggs & Stratton, based in Wauwatosa, Wisconsin, built a collaborative extranet called BriggsNetwork.com, linking it to its customers and suppliers, that is available in eight different languages. The company produces air-cooled gasoline engines for outdoor power equipment and uses more than 35,000 distributors worldwide. Suppliers and manufacturing customers can log onto the extranet to check manufacturing specifications, view upcoming sales promotions, and obtain parts and warranty information. Distributors can link their own Web sites to portions of the Briggs & Stratton extranet of special interest to their customers so that these customers see information that is immediately available and up to date.

Users of the extranet see different data, depending on whether they are manufacturing customers, distributors, or dealers. The information available includes searchable libraries of product brochures, marketing material, and two- and three-dimensional engine drawings, as well as an on-line calendar to help

dealers schedule training classes with their distributors. The company's regional managers can publish information unique to the regions they oversee. Briggs & Stratton provides its end customers with some of this company information through BriggsandStratton.com. Through this consumer Web site, users can access sales catalogs of equipment powered by Briggs & Stratton; obtain on-line advice to locate products that meet their needs; and locate retail outlets, such as Home Depot, Sears or Lowe's, that carry the company's products. Briggs & Stratton also uses Digex to host Web sites for smaller retailers who lack the resources to maintain their own Web presence (McDougall, 2001). Table 2-9 provides other examples of collaborative commerce.

Table 2-9	How Businesses Are Engaging In Collaborative Commerce
Business	**Collaborative Commerce Activities**
Cummins Inc	Extranet enables customers to access updates on their engine orders. Truck manufacturers can view early prototypes for Cummins line of engines and ask for modifications. Real-time design collaboration tools let Cummins engineers work with customers' engineers via the Web. A customer council reviews all significant updates to the Cummins site.
Group Dekko	Group of 12 independently operated manufacturing companies that produce components such as wire harnesses, molded plastic parts, metal stamping for automobiles, and office furniture uses a common shared data repository to coordinate partner firms to make sure they satisfy ISO 9000 international quality control standards. Partner firms share quality standards, documents, graphics, engineering drawings, bills of material, pricing, and routing information. Partner firms, suppliers, and customers can be involved in the complete flow of design and product information.
Menasha	Packaging company lets customers use the Web to proof products, change colors and specifications, and check scheduling directly in its enterprise resource planning (ERP) system.
American Axle and Manufacturing	Manufacturer of automobile driveline systems, chassis components, and forged products uses the Web to share photos of defective parts that stall its assembly line, discuss the problem, and solve it on the spot.

Internet technology is making this level of collaboration possible by providing a platform where systems from different companies can seamlessly exchange information. Web enabled networks for the coordination of transorganizational business processes provide an infrastructure for collaborative commerce activities. Such networks can be termed private industrial networks, and they permit firms and their business partners to share information about product design and development, marketing, inventory, and production scheduling, iincluding transmission of graphics, e-mail, and CAD drawings. Many of these networks are "owned" and managed by large companies who use them to coordinate purchases, orders, and other activities with their suppliers, distributors, and selected business partners.

For instance, Procter & Gamble (P&G), the world's largest consumer goods company, developed an integrated industry-wide system to coordinate grocery store point-of-sale systems with grocery store warehouses, shippers, its own manufacturing facilities, and its suppliers of raw materials. This single industry-spanning system effectively allows P&G to monitor the movement of all its products from raw materials to customer purchase. P&G uses data collected from point-of-sale terminals to trigger shipments to retailers of items that customers have purchased and that need restocking. Electronic links to suppliers enable P&G to order materials from its own suppliers when its inventories are low. The system helps P&G reduce its inventory by allowing the company to produce products as they are demanded by retailers. P&G is implementing an Ultimate Supply System that uses Internet technology to link retailers and suppliers to its private corporate intranet. By having retailers and suppliers integrate their systems with P&G's systems, P&G hopes to reduce product cycle time by half, inventory costs by $4.5 billion, and systems costs by $5 billion.

Similarly, Safeway U.K. has electronic links to suppliers where it can share information about forecasts, shelf space, and inventory in its supermarkets so suppliers can track demand for their products, adjust production, and adjust the timing and size of deliveries. The suppliers can download Safeway's information into their enterprise systems or production planning systems. Suppliers send Safeway information about product availability, production capacity, and inventory levels.

Although private industrial networks are primarily used today to coordinate the activities of a single firm and its business partners, some can encompass an entire industry, coordinating the business processes for the key players in that industry, including suppliers, transporters, production firms, distributors, and retailers. For example, the OASIS system Web sites link U.S. electrical utility companies in regional power pool groups to sell their surplus power to wholesalers and to locate the transmission facilities for moving the power between its source and the customers.

A few industrial networks have been built to support collaboration among firms in multiple industries. General Mills, Kellogg, Land O'Lakes, and Monsanto now use a common system based on Internet technology to share their excess shipping capacity. The system uses a private network to coordinate underutilized shipping capacity of container trucks and railroad cars to reduce participating members' logistics costs.

[http://gmx.xmu.edu.cn/ews/business/emis/chapter02.htm - top](http://gmx.xmu.edu.cn/ews/business/emis/chapter02.htm) **Enterprise Systems**

Organizations have internal business processes and flows of information that can also benefit from tighter integration. A large organization typically has many different kinds of information systems that support different functions, organizational levels, and business processes. Most of these systems are built around different functions, business units and business processes that do not "talk" to each other, and managers might have a hard time assembling the data they need for a comprehensive, overall picture of the organization's operations. For instance, sales personnel might not be able to tell at the time they place an order whether the items that were ordered were in inventory; customers could not track their orders; and manufacturing could not communicate easily with finance to plan for new production. This fragmentation of data in hundreds of separate systems could thus have a negative impact on organizational efficiency and business performance. Figure 2-16 illustrates the traditional arrangement of information systems.

| Figure 2-16 | Traditional view of systems |

In most organizations today, separate systems built over a long period of time support discrete business processes and discrete business functions. The organization's systems rarely include vendors and customers.

Many organizations are now building enterprise systems, also known as enterprise resource planning (ERP) systems, to solve this problem. Enterprise software models and automates many business processes, such as filling an order or scheduling a shipment, with the goal of integrating information across the company and eliminating complex, expensive links between computer systems in different areas of the business. Information that was previously fragmented in different systems can seamlessly flow throughout the firm so that it can be shared by business processes in manufacturing, accounting, human resources, and other areas of the firm. Discrete business processes from sales, production, finance, and logistics can be integrated into company-wide business processes that flow across organizational levels and functions. An enterprise-wide technical platform serves all processes and levels. Figure 2-17 illustrates how enterprise systems work.
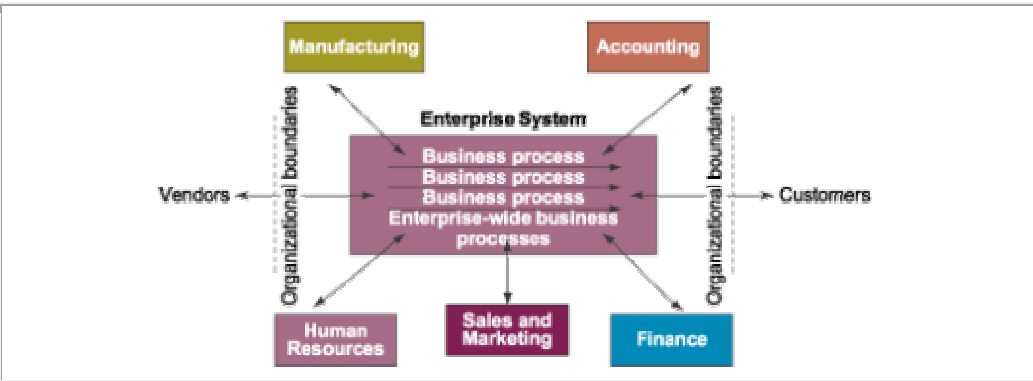
| Figure 2-17 | Enterprise systems |

Enterprise systems can integrate the key business processes of an entire firm into a single software system that allows information to flow seamlessly throughout the organization. These systems may include transactions with customers and vendors.

The enterprise system collects data from various key business processes (see Table 2-10) and stores the data in a single comprehensive data repository where they can be used by other parts of the business. Managers emerge with more precise and timely information for coordinating the daily operations of the business and a firmwide view of business processes and information flows.

Table 2-10	Business Processes Supported By Enterprise Systems

Manufacturing processes, including inventory management, purchasing, shipping, production planning, material requirements planning, and plant and equipment maintenance

Manufacturing processes, including inventory management, purchasing, shipping, production planning, material requirements planning, and plant and equipment maintenance

Financial and accounting processes, including accounts payable, accounts receivable, cash management and forecasting, product-cost accounting, cost-center accounting, asset accounting, general ledger, and financial reporting

Sales and marketing processes, including order processing, pricing, shipping, billing, sales management, and sales planning

Human resource processes, including personnel administration, time accounting, payroll, personnel planning and development, benefits accounting, applicant tracking, and travel expense reporting

For instance, when a sales representative in Brussels enters a customer order, the data flow automatically to others in the company who need to see them. The factory in Hong Kong receives the order and begins production. The warehouse checks its progress on-line and schedules the shipment date. The warehouse can check its stock of parts and replenish whatever the factory has depleted. The enterprise system stores production information, where it can be accessed by customer service representatives to track the progress of the order through every step of the manufacturing process. Updated sales and production data automatically flow to the accounting department. The system transmits information for calculating the salesperson's commission to the payroll department. The system also automatically recalculates the company's balance sheets, accounts receivable and payable ledgers, cost-center accounts, and available cash. Corporate headquarters in London can view up-to-the-minute data on sales, inventory, and production at every step of the process, as well as updated sales and production forecasts and calculations of product cost and availability.

Benefits and Challenges of Enterprise Systems

Enterprise systems promise to integrate the diverse business processes of a firm into a single, integrated information architecture, but they also present major challenges.

Benefits of Enterprise Systems

Enterprise systems promise to greatly change four dimensions of business: firm structure, management process, technology platform, and business capability. Companies can use enterprise systems to support organizational structures that were not previously possible or to create a more disciplined organizational culture. For example, they might use enterprise systems to integrate the corporation across geographic or business unit boundaries or to create a more uniform organizational culture in which everyone uses similar processes and information. An enterprise-enabled organization does business the same way worldwide, with cross-functional coordination and information flowing freely across business functions. Information supplied by an enterprise system is structured around cross-functional business processes, and it can improve management reporting and decision making. For example, an enterprise system might help management more easily determine which products are most or least profitable. An enterprise system could potentially supply management with better data about business processes and overall organizational performance.

Enterprise systems promise to provide firms with a single, unified, and all-encompassing information system technology platform that houses data on all the key business processes. The data have common, standardized definitions and formats that are accepted by the entire organization. You will learn more about the importance of standardizing organizational data in Chapter 7.

Enterprise systems can also help create the foundation for a customer or demand-driven organization. By integrating discrete business processes, such as sales, production, finance, and logistics, the entire organization can respond more efficiently to customer requests for products or information, forecast new products, and build and deliver them as demand requires. Manufacturing has better information to produce only what customers have ordered, procure exactly the right amount of components or raw materials to fill actual orders, stage production, and minimize the time that components or finished products are in inventory.

Enterprise systems have primarily focused on helping companies manage their internal manufacturing, financial, and human resource processes and were not originally designed to support supply chain management processes involving entities outside the firm. However, enterprise software vendors are starting to enhance their products so that firms can link their enterprise systems with vendors, suppliers, manufacturers, distributors, and retailers.

Enterprise systems can produce the integration among internal supply chain processes, such as sales, inventory, and production, that makes it easier for the firm to coordinate its activities with manufacturing partners and customers. If participants in the supply chain use the same enterprise software systems, their systems can exchange data without manual intervention.

Challenges of Enterprise Systems

Although enterprise systems can improve organizational coordination, efficiency, and decision making, they have proven very difficult to build. They require not only large technology investments but also fundamental changes in the way the business operates. Companies will need to rework their business processes to make information flow smoothly between them. Employees will have to take on new job functions and responsibilities. Organizations that don't understand that such changes will be required or are unable to make them will have problems implementing enterprise systems or they may not be able to achieve a higher level of functional and business process integration.

Enterprise systems require complex pieces of software and large investments of time, money, and expertise. This software is deeply intertwined with corporate business processes. It might take a large company three to five years to fully implement all of the organizational and technological changes required by an enterprise system. Because enterprise systems are integrated, it is difficult to make a change in only one part of the business without affecting other parts as well. There is the prospect that the new enterprise systems could eventually prove as brittle and hard to change as the old systems they replaced, binding firms to outdated business processes and systems.

Companies may also fail to achieve strategic benefits from enterprise systems if integrating business processes using the generic models provided by standard ERP software prevents the firm from using unique business processes that had been sources of advantage over competitors. Enterprise systems promote centralized organizational coordination and decision making, which may not be the best way for some firms to operate. There are companies that clearly do not need the level of integration provided by enterprise systems (Davenport, 2000 and 1998). Chapter 13 provides more detail on the organizational and technical challenges to enterprise system implementation.http://gmx.xmu.edu.cn/ews/business/emis/chapter02.htm - top

There are different ways of configuring information systems when businesses operate internationally, based on the firm's organizational structure.

Forms of Global Business Organization

There are four main forms of international business organization: domestic exporter, multinational, franchiser, and transnational, each with different patterns of organizational structure or governance. In each type of global business organization, business functions may be centralized (in the home country), decentralized (to local foreign units), and coordinated (all units participate as equals).

The domestic exporter is characterized by heavy centralization of corporate activities in the home country of origin. Production, finance/accounting, sales/marketing, human resources, and strategic management are set up to optimize resources in the home country. International sales are sometimes dispersed using agency agreements or subsidiaries, but even here foreign marketing is totally reliant on the domestic home base for marketing themes and strategies. Caterpillar Corporation and other heavy capital-equipment manufacturers fall into this category of firm.

The multinational firm concentrates financial management and control out of a central home base while decentralizing production, sales, and marketing operations to units in other countries. The products and services on sale in different countries are adapted to suit local market conditions. The organization becomes a far-flung confederation of production and marketing facilities in different countries. Many financial service firms, along with a host of manufacturers such as General Motors, Chrysler, and Intel, fit this pattern.

Franchisers have the product created, designed, financed, and initially produced in the home country, but rely heavily on foreign personnel for further production, marketing, and human resources. Food franchisers such as McDonald's, Mrs. Fields Cookies, and Kentucky Fried Chicken fit this pattern. McDonald's created a new form of fast-food chain in the United States and continues to rely largely on the United States for inspiration of new products, strategic management, and financing. Nevertheless, because the product must be produced locally—it is perishable—extensive coordination and dispersal of production, local marketing, and local recruitment of personnel are required.

Transnational firms have no single national headquarters but instead have many regional headquarters and perhaps a world headquarters. In a transnational strategy, nearly all the value-adding activities are managed from a global perspective without reference to national borders, optimizing sources of supply and demand wherever they appear, and taking advantage of any local competitive advantages. The governance of these firms has been likened to a federal structure in which there is a strong central management core of decision making, but considerable dispersal of power and financial muscle throughout the global divisions. Few companies have actually attained transnational status, but Citicorp, Sony, Ford, and others are attempting this transition.http://gmx.xmu.edu.cn/ews/business/emis/chapter02.htm - top

Global System Configuration

Information technology and improvements in global telecommunications are giving international firms more flexibility in their global business design.

Figure 2-18 depicts four types of systems configuration for global business organizations. *Centralized systems* are those in which systems development and operation occur totally at the domestic home base. *Duplicated systems* are those in which development occurs at the home base but operations are handed over to autonomous units in foreign locations. *Decentralized systems* are those in which each foreign unit designs its own unique solutions and systems. *Networked systems* are those in which systems development and operations occur in an integrated and coordinated fashion across all units.

SYSTEM CONFIGURATION	BUSINESS ORGANIZATION			
	Domestic Exporter	Multinational	Franchiser	Transnational
Centralized	X			
Duplicated			X	
Decentralized	x	X	x	
Networked		x		X

Figure 2-18	Global business organization and systems configurations

The large Xs show the dominant patterns, and the small Xs show the emerging patterns. For instance, domestic exporters rely predominantly on centralized systems, but there is continual pressure and some development of decentralized systems in local marketing regions.

As can be seen in Figure 2-18, domestic exporters tend to have highly centralized systems in which a single domestic systems development staff develops worldwide applications. Multinationals allow foreign units to devise their own systems solutions based on local needs with few if any applications in common with headquarters (the exceptions being financial reporting and some telecommunications applications). Franchisers typically develop a single system, usually at the home base, and then replicate it around the world. Each unit, no matter where it is located, has identical applications. Firms organized along transnational lines use networked systems that span multiple countries using a powerful telecommunications backbone and a shared management culture that crosses cultural barriers. One can see the networked systems structure in financial services where the homogeneity of the product—money and money instruments—seems to overcome national and cultural barriers.

> Management Wrap-Up

Enterprise systems require management to take a firmwide view of business processes and information flows. Managers need to determine which business processes should be integrated, the short- and long-term benefits of this integration, and the appropriate level of financial and organizational resources to support this integration.

There are many types of information systems in an organization that support different organizational levels, functions, and business processes. Some of these systems, including those for supply chain management and customer relationship management, span more than one function or business process and may be tied to the business processes of other organizations. Systems integrating information from different business functions, business processes and organizations often require extensive organizational change.

Information systems that create firmwide or industry-wide information flows and business processes require major technology investments and planning. Firms must have an information technology (IT) infrastructure that can support organization-wide or industry-wide computing.

For Discussion

1. Review the payroll TPS illustrated in Figure 2-3. How could it provide information for other types of systems in the firm?

2. Adopting an enterprise system is a key business decision as well as a technology decision. Do you agree? Why or why not? Who should make this decision?

Summary

1. *What are the key system applications in a business? What role do they play?* There are six major types of information systems in contemporary organizations. Operational-level systems are transaction processing systems (TPS), such as payroll or order processing, that track the flow of the daily routine transactions that are necessary to conduct business. Knowledge-level systems support clerical, managerial, and professional workers. They consist of office systems for increasing data workers' productivity and knowledge work systems for enhancing knowledge workers' productivity. Management-level systems (MIS and DSS) provide the management control level with information for monitoring, controlling, and decision-making. Most MIS reports condense information from TPS and are not highly analytical. Decision-support systems (DSS) support management decisions when these decisions are unique, rapidly changing, and not specified easily in advance. They have more advanced analytical models and data analysis capabilities than MIS and often draw on information from external as well as internal sources. Executive support systems (ESS) support the strategic level by providing a generalized computing and communications environment to assist senior management's decision making. They have limited analytical capabilities but can draw on sophisticated graphics software and many sources of internal and external information.

   The various types of systems in the organization exchange data with one another. TPS are a major source of data for other systems, especially MIS and DSS. ESS primarily receive data from lower-level systems. The different systems in an organization have traditionally been loosely integrated.

2. *How do information systems support the major business functions: sales and marketing, manufacturing and production, finance and accounting, and human resources?* At each level of the organization there are information systems supporting the major functional areas of the business. Sales and marketing systems help the firm identify customers for the firm's products or services, develop products and services to meet customers' needs, promote the products and services, sell the products and services, and provide ongoing customer support. Manufacturing and production systems deal with the planning, development, and production of products and services, and controlling the flow of production. Finance and accounting systems keep track of the firm's financial assets and fund flows. Human resources systems maintain employee records; track employee skills, job performance, and training; and support planning for employee compensation and career development.

3. *Why should managers pay attention to business processes? What are the benefits of using information systems to support business processes, including those for customer relationship management and supply chain management?* Business processes refer to the manner in which work is organized, coordinated, and focused to produce a valuable product or service. Business processes are concrete work flows of material, information, and knowledge. They also represent unique ways in which organizations coordinate work, information, and knowledge and the ways in which management chooses to coordinate work. Managers need to pay attention to business processes because they determine how well the organization can execute, and thus are a potential source of strategic success or failure. Although each of the major business functions has its own set of business processes, many other business processes are cross-functional, such as fulfilling an order. Information systems can help organizations achieve great efficiencies by automating parts of these processes or by helping organizations rethink and streamline these processes, especially those for customer relationship management and supply chain management. Customer relationship management uses information systems to coordinate all of the business processes surrounding the firm's interactions with its customers. Supply chain management is the close linkage of activities involved in buying, making, and moving products. Information systems make supply chain management more efficient by helping companies coordinate, schedule, and control procurement, production, inventory management, and delivery of products and services to customers.

4. *What are the business benefits of using collaborative commerce, private industrial networks and enterprise systems?* Collaborative commerce relies on digital technologies to enable multiple organizations to collaboratively design, develop, build, move, and manage products through their lifecycles. A firm engaged in collaborative commerce with its suppliers and customers can achieve

new efficiencies by reducing product design cycles, minimizing excess inventory, forecasting demand, and keeping partners and customers informed. Private industrial networks are Web-enabled networks that support collaborative commerce activities by providing an infrastructure for transorganizational business processes and information flows.

Enterprise systems integrate the key business processes of a firm into a single software system so that information can flow throughout the organization, improving coordination, efficiency, and decision making. Enterprise systems promise efficiencies from better coordination of both internal and external business processes. Enterprise systems can help create a more uniform organization in which everyone uses similar processes and information, and measures their work in terms of organization-wide performance standards. The coordination of sales, production, finance, and logistics processes provided by enterprise systems helps organizations respond more rapidly to customer demands.

Enterprise systems are very difficult to implement successfully. They require extensive organizational change, use complicated technologies, and require large up-front costs for long-term benefits that are difficult to quantify. Once implemented, enterprise systems are very difficult to change. Management vision and foresight are required to take a firmwide and industry-wide view of problems and to find solutions that realize strategic value from the investment.

5. *What types of information systems are used by companies that operate internationally?* There are four basic global forms of business organization: domestic exporter, multinational, franchiser, and transnational. Each works best with a different systems configuration. Transnational firms must develop networked system configurations and permit considerable decentralization of development and operations. Franchisers tend to duplicate systems across many countries and use centralized financial controls. Multinationals typically rely on decentralized independence among foreign units with some movement toward development of networks. Domestic exporters typically are centralized in domestic headquarters with some decentralized operations permitted.

Key Terms

bullwhip effect
    Large fluctuations in inventories along the supply chain resulting from small unanticipated fluctuations in demand.

business processes
    The unique ways in which organizations coordinate and organize work activities, information, and knowledge to produce a product or service.

collaborative commerce
    The use of digital technologies to enable multiple organizations to collaboratively design, develop, build, and manage products through their lifecycles.

customer relationship management (CRM)
    Business and technology discipline to coordinate all of the business processes for dealing with customers.

decision-support systems (DSS)
    Information systems at the organization's management level that combine data and sophisticated analytical models or data analysis tools to support nonroutine decision making.

desktop publishing
    Technology that produces professional-quality documents combining output from word processors with design, graphics, and special layout features.

document imaging systems
Systems that convert documents and images into digital form so that they can be stored and accessed by the computer.

domestic exporter
Form of business organization characterized by heavy centralization of corporate activities in the home country of origin.

enterprise systems
Firmwide information systems that integrate key business processes so that information can flow freely between different parts of the firm.

executive support systems (ESS)
Information systems at the organization's strategic level designed to address unstructured decision making through advanced graphics and communications.

finance and accounting information systems
Systems that keep track of the firm's financial assets and fund flows.

franchiser
Form of business organization in which a product is created, designed, financed, and initially produced in the home country, but for product-specific reasons relies heavily on foreign personnel for further production, marketing, and human resources.

human resources information systems
Systems that maintain employee records; track employee skills, job performance, and training; and support planning for employee compensation and career development.

knowledge work systems (KWS)
Information systems that aid knowledge workers in the creation and integration of new knowledge in the organization.

knowledge-level systems
Information systems that support knowledge and data workers in an organization.

management information systems (MIS)
Information systems at the management level of an organization that serve the functions of planning, controlling, and decision making by providing routine summary and exception reports.

management-level systems
Information systems that support the monitoring, controlling, decision-making, and administrative activities of middle managers.

manufacturing and production information systems
Systems that deal with the planning, development, and production of products and services, and with controlling the flow of production.

multinational
Form of business organization that concentrates financial management and control out of a central home base while decentralizing production, sales, and marketing operations to units in other countries.

office systems
Computer systems, such as word processing, electronic mail systems, and scheduling systems, that are designed to increase the productivity of data workers in the office.

operational-level systems
> Information systems that monitor the elementary activities and transactions of the organization.

private industrial networks
> Web-enabled networks linking systems of multiple firms in an industry for the coordination of transorganizational business processes.

reverse logistics
> The return of items from buyers to sellers in a supply chain.

sales and marketing information systems
> Systems that help the firm identify customers for the firm's products or services, develop products and services to meet customers' needs, promote these products and services, sell the products and services, and provide ongoing customer support.

strategic-level systems
> Information systems that support the long-range planning activities of senior management.

supply chain
> Network of organizations and business processes for procuring materials, transforming raw materials into intermediate and finished products, and distributing the finished products to customers.

supply chain management
> Close linkage and coordination of activities involved in buying, making, and moving a product.

transaction processing systems (TPS)
> Computerized systems that perform and record the daily routine transactions necessary to conduct the business; they serve the organization's operational level.

transnational
> Truly global form of business organization with no national headquarters; value-added activities are managed from a global perspective without reference to national borders, optimizing sources of supply and demand and local competitive advantage.

word processing
> Office system technology that facilitates the creation of documents through computerized text editing, formatting, storing, and printing.

Review Questions

1. Identify and describe the four levels of the organizational hierarchy. What types of information systems serve each level?

2. List and briefly describe the major types of systems in organizations.

3. What are the five types of TPS in business organizations? What functions do they perform? Give examples of each.

4. Describe the functions performed by knowledge work and office systems and some typical applications of each.

5. What are the characteristics of MIS? How do MIS differ from TPS? From DSS

6. What are the characteristics of DSS? How do they differ from those of ESS

7. Describe the relationship between TPS, office systems, KWS, MIS, DSS, and ESS.

8. List and describe the information systems serving each of the major functional areas of a business.

9. What is a business process? Give two examples of processes for functional areas of the business and one example of a cross-functional process.

10. What is customer relationship management? Why is it so important to businesses? How do information systems facilitate customer relationship management?

11. What is supply chain management? What activities does it comprise? Why is it so important to businesses?

12. How do information systems facilitate supply chain management

13. What is collaborative commerce? How can organizations benefit from it

14. How can organizations benefit from participating in private industrial networks

15. What are enterprise systems? How do they change the way an organization works

16. What are the benefits and challenges of implementing enterprise systems

17. Describe the four major types of global business organization and the system configuration that is most appropriate for supporting each type.