What Is an Information System?

We begin with a simple definition that we can expand upon later in the chapter. An *information system* (IS) can be any organized combination of people, hardware, software, communications networks, data resources, and policies and procedures that stores, retrieves, transforms, and disseminates information in an organization. People rely on modern information systems to communicate with one another using a variety of physical devices *(hardware)*, information processing instructions and procedures *(software)*, communications channels *(networks)*, and stored data *(data resources)*. Although today's information systems are typically associated with computers, we have been using information systems since the dawn of civilization. Even today we make regular use of information systems that have nothing to do with a computer. Consider some of the following examples of information systems:

- **Smoke signals for communication** were used as early as recorded history and can account for the human discovery of fire. The pattern of smoke transmitted valuable information to others who were too far to see or hear the sender.

- **Card catalogs in a library** are designed to store data about the books in an organized manner that allows readers to locate a particular book by its title, author name, subject, or a variety of other approaches.

- **Your book bag, day planner, notebooks, and file folders** are all part of an information system designed to help you organize the inputs provided to you via handouts, lectures, presentations, and discussions. They also help you process these inputs into useful outputs: homework and good exam grades.

- **The cash register at your favorite fast-food restaurant** is part of a large information system that tracks the products sold, the time of a sale, inventory levels, and the amount of money in the cash drawer; it also contributes to the analysis of product sales in any combination of locations anywhere in the world.

- **A paper-based accounting ledger** as used before the advent of computer-based accounting systems is an iconic example of an information system. Businesses used this type of system for centuries to record the daily transactions and to keep a record of the balances in their various business and customer accounts.

Figure 1.2 illustrates a useful conceptual framework that organizes the knowledge presented in this text and outlines areas of knowledge you need about information systems. It emphasizes that you should concentrate your efforts in the following five areas of IS knowledge:

- **Foundation Concepts.** Fundamental behavioral, technical, business, and managerial concepts about the components and roles of information systems. Examples include basic information system concepts derived from general systems theory or

FIGURE 1.2

A framework that outlines the major areas of information systems knowledge needed by business professionals.
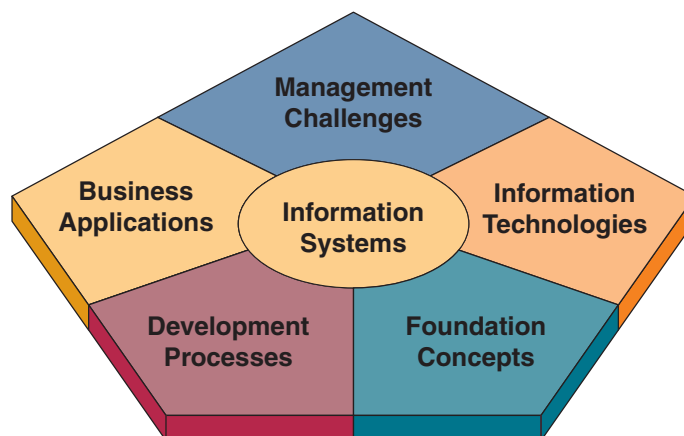
competitive strategy concepts used to develop business applications of information technology for competitive advantage. Chapters 1 and 2 and other chapters of the text support this area of IS knowledge.

- **Information Technologies.** Major concepts, developments, and management issues in information technology—that is, hardware, software, networks, data management, and many Internet-based technologies. Chapters 3 and 4 provide an overview of computer hardware and software technologies, and Chapters 5 and 6 cover key data resource management and telecommunications network technologies for business.

- **Business Applications.** The major uses of information systems for the operations, management, and competitive advantage of a business. Chapters 7 and 8 cover applications of information technology in functional areas of business such as marketing, manufacturing, and accounting. Chapter 9 focuses on e-commerce applications that most companies use to buy and sell products on the Internet, and Chapter 10 covers the use of information systems and technologies to support decision making in business.

- **Development Processes.** How business professionals and information specialists plan, develop, and implement information systems to meet business opportunities. Several developmental methodologies are explored in Chapters 11 and 12, including the systems development life cycle and prototyping approaches to business application development.

- **Management Challenges.** The challenges of effectively and ethically managing information technology at the end-user, enterprise, and global levels of a business. Thus, Chapter 13 focuses on security challenges and security management issues in the use of information technology, while Chapter 14 covers some of the key methods business managers can use to manage the information systems function in a company with global business operations.

Although a seemingly endless number of software applications exist, there are three fundamental reasons for all business applications of information technology. They are found in the three vital roles that information systems can perform for a business enterprise:

- Support of business processes and operations.
- Support of decision making by employees and managers.
- Support of strategies for competitive advantage.

Figure 1.3 illustrates how these fundamental roles interact in a typical organization. At any given moment, information systems designed to support business processes and operations may also be providing data to, or accepting data from, systems
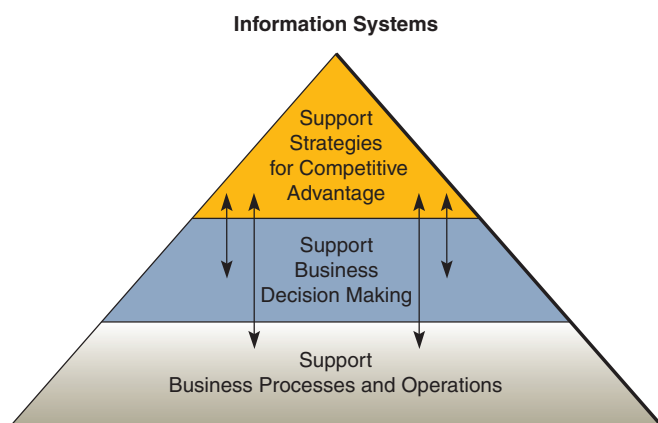
THE FUNDAMENTAL ROLES OF IS IN BUSINESS
LO 1-2
LO 1-3

Information Systems

Support Strategies for Competitive Advantage

Support Business Decision Making

Support Business Processes and Operations

FIGURE 1.3

The three fundamental roles of the business applications of information systems. Information systems provide an organization with support for business processes and operations, decision making, and competitive advantage.

focused on business decision making or achieving competitive advantage. The same is true for the other two fundamental roles of IS. Today's organizations are constantly striving to achieve integration of their systems to allow information to flow freely through them, which adds even greater flexibility and business support than any of the individual system roles could provide.

Let's look at a typical retail store as a good example of how these **_roles of IS in business_** can be implemented.

The Fundamental Roles of IS in Business

Support of Business Processes and Operations. As a consumer, you regularly encounter information systems that support the business processes and operations at the many retail stores where you shop. For example, most retail stores now use **_computer-based information systems_** to help their employees record customer purchases, keep track of inventory, pay employees, buy new merchandise, and evaluate sales trends. Store operations would grind to a halt without the support of such information systems.

Support of Business Decision Making. Information systems also help store managers and other business professionals make better decisions. For example, decisions about what lines of merchandise need to be added or discontinued and what kind of investments they require are typically made after an analysis provided by computer-based information systems. This function not only supports the decision making of store managers, buyers, and others, but also helps them look for ways to gain an advantage over other retailers in the competition for customers.

Support of Strategies for Competitive Advantage. Gaining a strategic advantage over competitors requires the innovative application of information technologies. For example, store management might make a decision to install touch-screen kiosks in all stores, with links to the e-commerce Web site for online shopping. This offering might attract new customers and build customer loyalty because of the ease of shopping and buying merchandise provided by such information systems. Thus, strategic information systems can help provide products and services that give a business a comparative advantage over its competitors.

Welch's: Balancing Truckloads with Business Intelligence

Given dramatic fluctuations in gas prices, it's no surprise that companies want to find ways to rein in transportation costs. One company finding success in that endeavor is Welch's, a well-known purveyor of food and packaged consumer goods. The company is tapping the power of business intelligence for better insight into its supply-chain operations, which in turn can help keep transportation expenses lower. Welch's, the $654 million manufacturer known for its jams, jellies, and juices, recently installed an on-demand BI application from Oco.

One way Welch's is leveraging the Oco BI application is to ensure that truckloads delivered by its carriers go out full.

The idea is that customers are already paying for the full truck when it delivers goods, even if it's only halfway or three-quarters loaded. With the BI system, Welch's can tell if a buyer's shipment is coming up short of full capacity and help them figure out what else they can order to max it out, thus saving on future shipping costs.

"Welch's can go to the customer and say, 'You're only ordering this much. Why not round out the load with other things you need? It will be a lot cheaper for you,'" says Bill Copacino, president and CEO of Oco. "If you're able to put

4,000 more pounds on the 36,000-pound shipment, you're getting a 10 percent discount on transportation costs," he adds.

"We're essentially capturing every element—from the customer orders we receive, to bills of lading on every shipment we make, as well as every data element on every freight bill we pay," says Bill Coyne, director of purchasing and logistics for Welch's. "We dump them all into one data warehouse [maintained by Oco], and we can mix-and-match and slice-and-dice any way we want." Coyne says that Welch's tries to ship its products out of its distribution center five days a week. "But we found ourselves just totally overwhelmed on Fridays," he says. "We would complain, 'How come there are so many orders on Friday?'"

Now, the new system helps Welch's balance its daily deliveries so that it uses about the same number of trucks, rather than hiring seven trucks on a Monday, five on a Tuesday, eight on a Wednesday, and so forth.

The company reaps transportation savings by using a stable number of trucks daily—"as capacity is not jumping all over the place," Copacino says.

"We are gaining greater visibility into cost-savings opportunities, which is especially important in light of rising fuel and transportation costs," says Coyne. Welch's spends more than $50 million each year on transportation expenses, and the Oco BI application and reporting features have become critical in a very short period of time. "We literally can't go any amount of time without knowing this stuff," Coyne says.

SOURCE: Ted Samson, "Welch's Leverages BI to Reduce Transport Costs," *InfoWorld*, October 16, 2008; and Thomas Wailgum, "Business Intelligence and On-Demand: The Perfect Marriage?" *CIO Magazine*, March 27, 2008.

TRENDS IN INFORMATION SYSTEMS
LO 1-3

The business applications of information systems have expanded significantly over the years. Figure 1.4 summarizes these changes.

Until the 1960s, the role of most information systems was simple: transaction processing, record keeping, accounting, and other *electronic data processing* (EDP) applications. Then another role was added, namely, the processing of all these data into useful, informative reports. Thus, the concept of *management information systems* (MIS) was born. This new role focused on developing business applications that provided managerial end users with predefined management reports that would give managers the information they needed for decision-making purposes.

By the 1970s, it was evident that the standard "off-the-shelf" information products produced by management information systems were not adequately meeting the decision-making needs of management, so the concept of *decision support systems* (DSS) was born. The new role for information systems was to provide managers with ad hoc, interactive support of their decision-making processes. This support would be tailored to the unique decisions and decision-making styles of managers as they confronted specific types of problems in the real world.

In the 1980s, several new roles for information systems appeared. First, the rapid development of microcomputer processing power, application software packages, and telecommunications networks gave birth to the phenomenon of *end-user computing*. End users could now use their own computing resources to support their job requirements instead of waiting for the indirect support of centralized corporate information services departments.
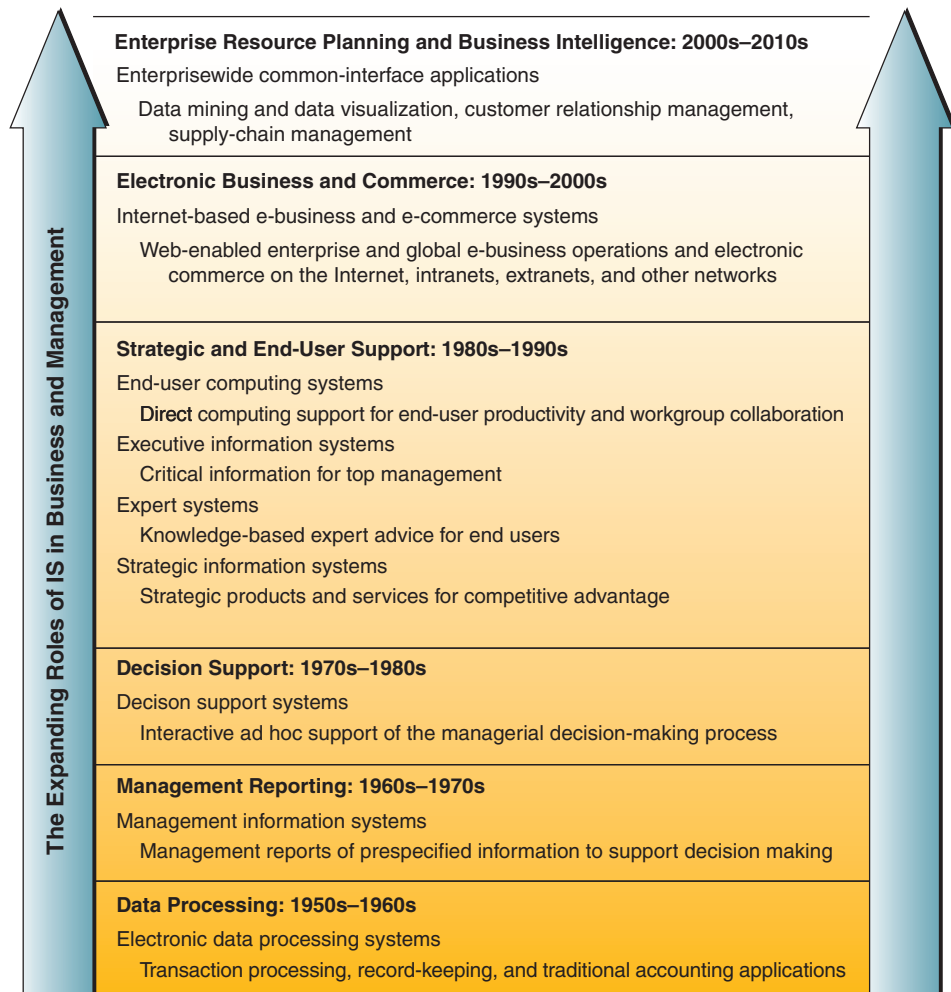
Second, it became evident that most top corporate executives did not directly use (read "have time to use") either the voluminous reports from management information systems or the complex analytical modeling capabilities of decision support systems, so the concept of *executive information systems* (EIS) developed. These "executive summary" information systems were created to give top executives an easy way to get

The Expanding Roles of IS in Business and Management

Enterprise Resource Planning and Business Intelligence: 2000s–2010s

Enterprisewide common-interface applications

Data mining and data visualization, customer relationship management, supply-chain management

Electronic Business and Commerce: 1990s–2000s

Internet-based e-business and e-commerce systems

Web-enabled enterprise and global e-business operations and electronic commerce on the Internet, intranets, extranets, and other networks

Strategic and End-User Support: 1980s–1990s

End-user computing systems

Direct computing support for end-user productivity and workgroup collaboration

Executive information systems

Critical information for top management

Expert systems

Knowledge-based expert advice for end users

Strategic information systems

Strategic products and services for competitive advantage

Decision Support: 1970s–1980s

Decison support systems

Interactive ad hoc support of the managerial decision-making process

Management Reporting: 1960s–1970s

Management information systems

Management reports of prespecified information to support decision making

Data Processing: 1950s–1960s

Electronic data processing systems

Transaction processing, record-keeping, and traditional accounting applications

the critical information they wanted, when they wanted it, and tailored to the formats they preferred.

Third, breakthroughs occurred in the development and application of artificial intelligence (AI) techniques to business information systems. Today's systems include intelligent software agents that can be programmed and deployed inside a system to act on behalf of their owner, system functions that can adapt themselves on the basis of the immediate needs of the user, virtual reality applications, advanced robotics, natural language processing, and a variety of applications for which artificial intelligence can replace the need for human intervention, thus freeing up knowledge workers for more complex tasks. *Expert systems* (ES) and other *knowledge-based systems* also forged a new role for information systems. Today, expert systems can serve as consultants to users by providing expert advice in limited subject areas. One look at Watson playing *Jeopardy* against the two best players in the world shows the power of machine learning to rapidly bring us new knowledge.

An important new role for information systems appeared in the 1980s and continued through the 1990s: the concept of a strategic role for information systems, sometimes called *strategic information systems* (SIS). In this concept, information technology becomes an integral component of business processes, products, and services that help a company gain a competitive advantage in the global marketplace.

The mid- to late 1990s saw the revolutionary emergence of *enterprise resource planning* (ERP) systems. This organization-specific form of a strategic information system integrates all facets of a firm, including its planning, manufacturing, sales, resource

management, customer relations, inventory control, order tracking, financial management, human resources, and marketing—virtually every business function. The primary advantage of these ERP systems lies in their common interface for all computer-based organizational functions and their tight integration and data sharing, necessary for flexible strategic decision making. We explore ERP and its associated functions in greater detail in Chapter 8.

We are also entering an era where a fundamental role for IS is *business intelligence* (BI). BI refers to all applications and technologies in the organization that are focused on the gathering and analysis of data and information that can be used to drive strategic business decisions. Through the use of BI technologies and processes, organizations can gain valuable insight into the key elements and factors—both internal and external—that affect their business and competitiveness in the marketplace. BI relies on sophisticated metrics and analytics to "see into the data" and find relationships and opportunities that can be turned into profits. We'll look closer at BI in Chapter 10.

Finally, the rapid growth of the Internet, intranets, extranets, and other interconnected global networks in the 1990s dramatically changed the capabilities of information systems in business at the beginning of the 21st century. Further, a fundamental shift in the role of information systems occurred. Internet-based and Web-enabled enterprises and global e-business and e-commerce systems are becoming commonplace in the operations and management of today's business enterprises. Information systems is now solidly entrenched as a strategic resource in the modern organization.

A closer look at Figure 1.4 suggests that though we have expanded our abilities with regard to using information systems for conducting business, today's information systems are still doing the same basic things that they began doing more than 50 years ago. We still need to process transactions, keep records, provide management with useful and informative reports, and support the foundational accounting systems and processes of the organization. What has changed, however, is that we now enjoy a much higher level of integration of system functions across applications, greater connectivity across both similar and dissimilar system components, and the ability to reallocate critical computing tasks such as data storage, processing, and presentation to take maximum advantage of business and strategic opportunities. Because of these increased capabilities, the systems of tomorrow will be focused on increasing both the speed and reach of our systems to provide us with greater decision-making accuracy, speed, and insight.
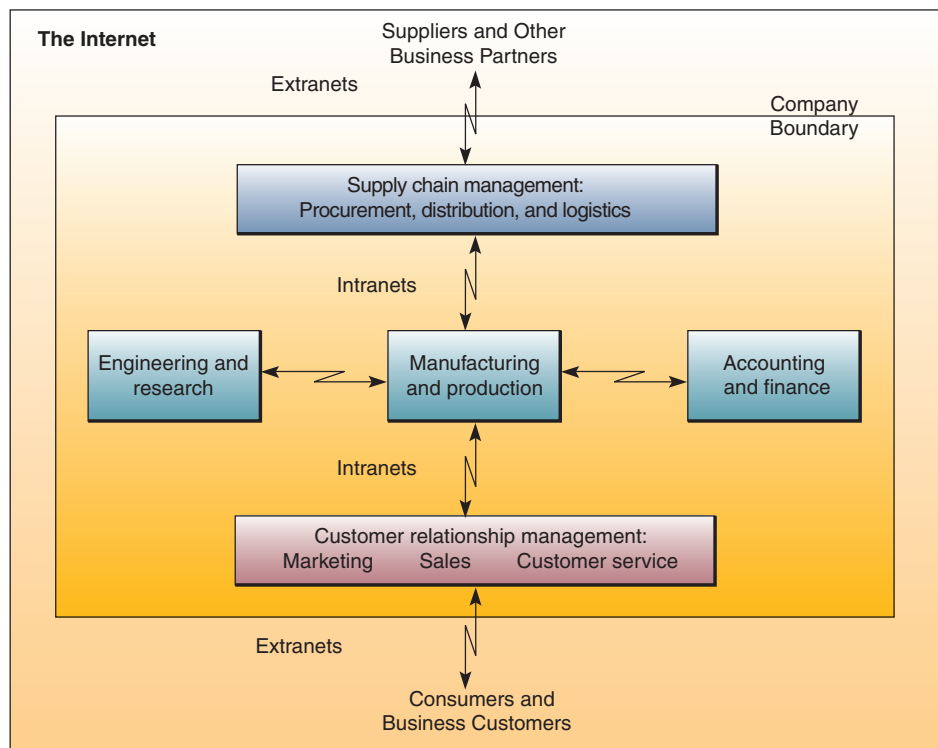
THE ROLE OF e-BUSINESS IN BUSINESS

The Internet and related technologies and applications have changed the ways businesses operate and people work, as well as how information systems support business processes, decision making, and competitive advantage. Thus, many businesses today are using Internet technologies to Web-enable their business processes and create innovative *e-business applications.* See Figure 1.5.

In this text, we define *e-business* as the use of Internet technologies to work and empower business processes, e-commerce, and enterprise collaboration within a company and with its customers, suppliers, and other business stakeholders. In essence, e-business can be more generally considered an *online exchange of value*. Any online exchange of information, money, resources, services, or any combination thereof falls under the e-business umbrella. The Internet and Internet-like networks—those inside the enterprise *(intranet)* and between an enterprise and its trading partners *(extranet)*—have become the primary information technology infrastructure that supports the e-business applications of many companies. These companies rely on e-business applications to (1) reengineer internal business processes, (2) implement e-commerce systems with their customers and suppliers, and (3) promote enterprise collaboration among business teams and workgroups.

Enterprise collaboration systems involve the use of software tools to support communication, coordination, and collaboration among the members of networked teams and workgroups. A business may use intranets, the Internet, extranets, and other

networks to implement such systems. For example, employees and external consultants may form a *virtual team* that uses a corporate intranet and the Internet for e-mail, videoconferencing, e-discussion groups, and Web pages of work-in-progress information to collaborate on business projects.

E-commerce is the buying, selling, marketing, and servicing of products, services, and information over a variety of computer networks. Many businesses now use the Internet, intranets, extranets, and other networks to support every step of the commercial process, including everything from advertising, sales, and customer support on the World Wide Web to Internet security and payment mechanisms that ensure completion of delivery and payment processes. For example, e-commerce systems include Internet Web sites for online sales, extranet access to inventory databases by large customers, and the use of corporate intranets by sales reps to access customer records for customer relationship management.

TYPES OF INFORMATION SYSTEMS
LO 1-4

Information systems are a "one-size-fits-all" concept. IS can be developed to perform a wide variety of related tasks or just a single task; for example, several *types of information systems* can be classified either as operations or management information systems. Figure 1.6 illustrates this conceptual classification of information systems applications. Information systems are categorized this way to spotlight the major role each plays in the operations and management of a business. Note, however, that there are many subcategories of information systems, and each plays an essential role in either the operation of the business or the execution of its chosen strategy. Let's look briefly at some examples of such information systems categories.

Operations Support Systems

Information systems have always been needed to process data generated by, and used in, business operations. Such *operations support systems* produce a variety of information products for internal and external use; however, they do not emphasize the specific
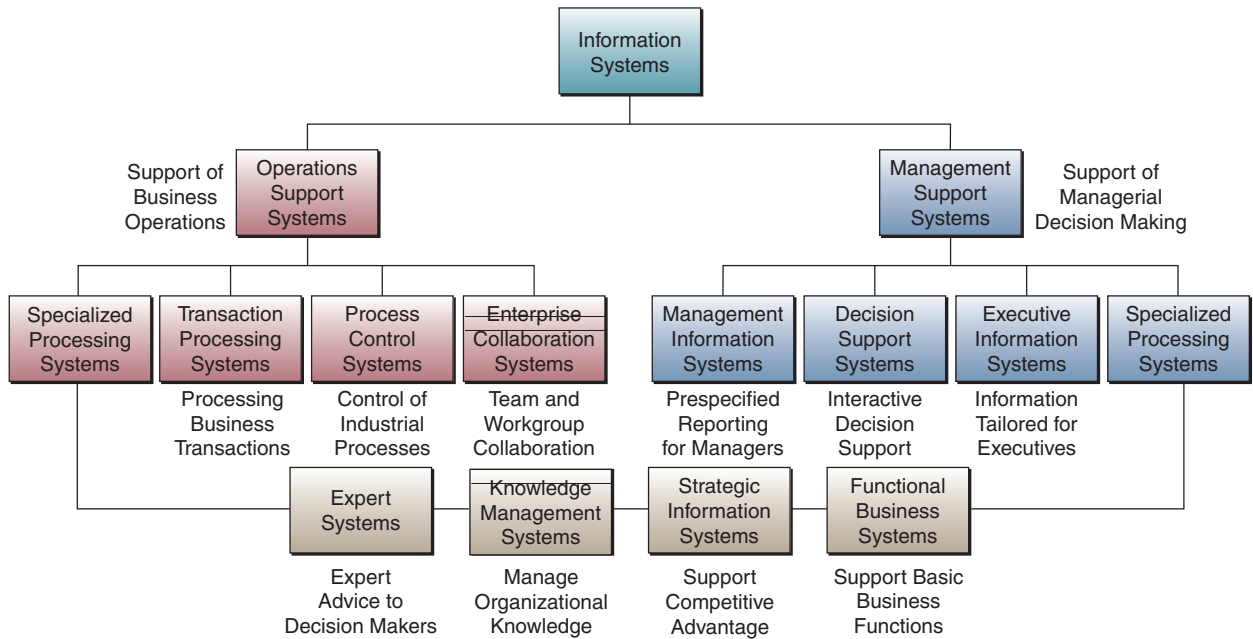
FIGURE 1.6

Operations and management classifications of information systems. Note how this conceptual overview emphasizes the main purposes of information systems that support business operations and managerial decision making.

information products that can best be used by managers. Further processing by management information systems is usually required. The role of a business firm's operations support systems is to process business transactions, control industrial processes, support enterprise communications and collaborations, and update corporate databases efficiently. See Figure 1.7.

Transaction processing systems are important examples of operations support systems that record and process the data resulting from business transactions. They process transactions in two basic ways. In *batch processing*, transactions data are accumulated over a period of time and processed periodically. In *real-time* (or *online*) processing, data are processed immediately after a transaction occurs. For example, point-of-sale (POS) systems at many retail stores use electronic cash register terminals to capture and transmit sales data electronically over telecommunications links to regional computer centers for immediate (real-time) or nightly (batch) processing. Figure 1.8 is an example of software that automates accounting transaction processing.

Process control systems monitor and control physical processes. For example, a petroleum refinery uses electronic sensors linked to computers to monitor chemical processes continually and make instant (real-time) adjustments that control the refinery process. *Enterprise collaboration systems* enhance team and workgroup communications and productivity and include applications that are sometimes called *office automation*

FIGURE 1.7

A summary of operations support systems with examples.

Operations Support Systems

- **Transaction processing systems.** Process data resulting from business transactions, update operational databases, and produce business documents. Examples: sales and inventory processing and accounting systems.

- **Process control systems.** Monitor and control industrial processes. Examples: petroleum refining, power generation, and steel production systems.

- **Enterprise collaboration systems.** Support team, workgroup, and enterprise communications and collaborations. Examples: e-mail, chat, and videoconferencing groupware systems.

FIGURE 1.8

QuickBooks is a popular accounting package that automates small office or home office (SOHO) accounting transaction processing while providing business owners with management reports.
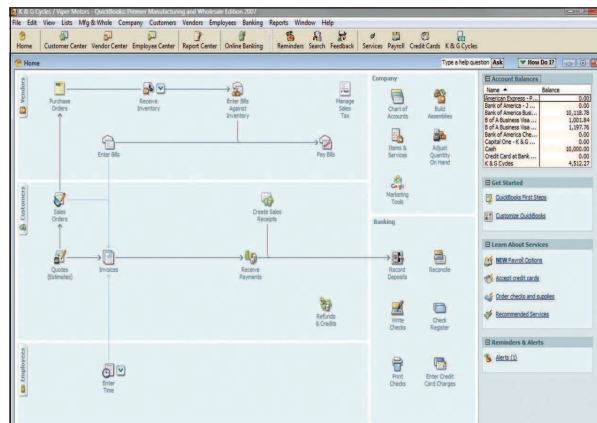
SOURCE: Courtesy of Quickbooks.

systems. For example, knowledge workers in a project team may use e-mail to send and receive e-messages or use videoconferencing to hold electronic meetings to coordinate their activities.

Management Support Systems

When information system applications focus on providing information and support for effective decision making by managers, they are called ***management support systems.*** Providing information and support for decision making by all types of managers and business professionals is a complex task. Conceptually, several major types of information systems support a variety of decision-making responsibilities: (1) management information systems, (2) decision support systems, and (3) executive information systems. See Figure 1.9.

Management information systems (MIS) provide information in the form of reports and displays to managers and many business professionals. They are the most common form of information system in an organization. For example, sales managers may use their networked computers and Web browsers to receive instantaneous displays about the sales results of their products and access their corporate intranet for daily sales analysis reports that evaluate sales made by each salesperson. *Decision support systems* (DSS) give direct computer support to managers during the decision-making process. These types of systems fall under the business intelligence or business analytics umbrella and will be discussed in detail in Chapter 10. For example, an advertising manager may use a DSS to perform a what-if analysis as part of the decision to determine how to spend advertising dollars. A production manager may use a DSS to decide how much product to manufacture, based on the expected sales associated with a future promotion and the location and availability of the raw materials necessary to

FIGURE 1.9

A summary of management support systems with examples.

| Management Support Systems |
| --- |
| • **Management information systems.** Provide information in the form of prespecified reports and displays to support business decision making. Examples: sales analysis, production performance, and cost trend reporting systems. |
| • **Decision support systems.** Provide interactive ad hoc support for the decision-making processes of managers and other business professionals. Examples: product pricing, profitability forecasting, and risk analysis systems. |
| • **Executive information systems.** Provide critical information from MIS, DSS, BI, and other sources tailored to the information needs of executives. Examples: systems for easy access to analyses of business performance, actions of competitors, and economic developments to support strategic planning. |
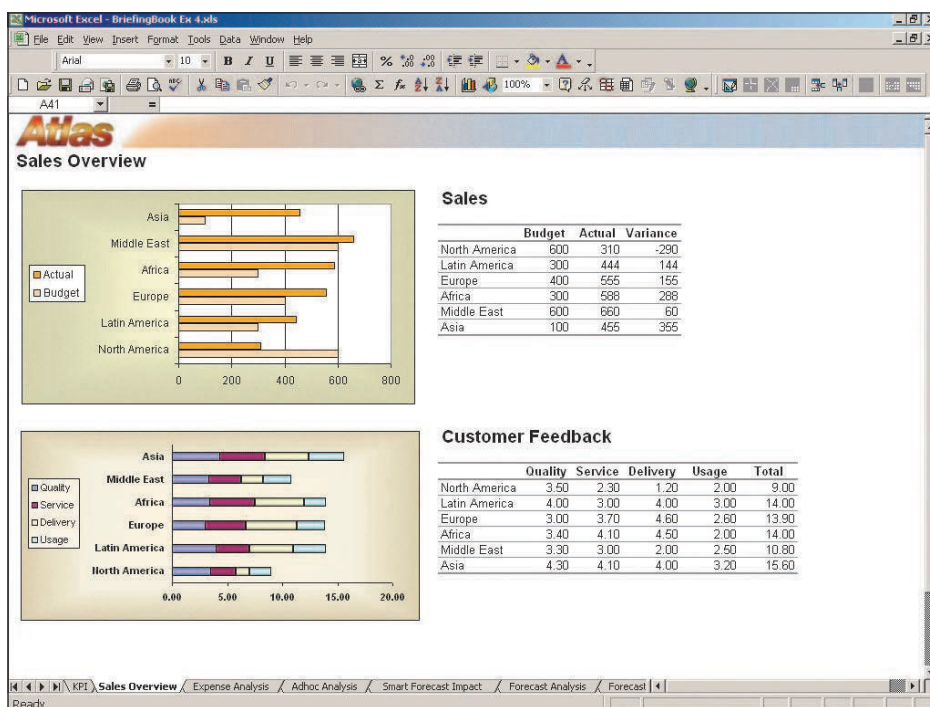
FIGURE 1.10

Management information systems provide information to business professionals in a variety of easy-to-use formats.

manufacture the product. *Executive information systems* (EIS) provide critical information from a wide variety of internal and external sources in easy-to-use displays to executives and managers. Think of an EIS as a "30,000-foot-high view of the organization." For example, top executives may use touch-screen terminals for an instant view of text and graphics displays that highlight key areas of organizational and competitive performance. Figure 1.10 is an example of an MIS report display.

Other Classifications of Information Systems

Several other categories of information systems can support either operations or management applications. For example, *expert systems* can provide expert advice for operational chores like equipment diagnostics or managerial decisions such as loan portfolio management. IBM's famous supercomputer, Watson, is an example of an expert system that can translate text input and use a complex search algorithm to find answers to questions. *Knowledge management systems* are knowledge-based information systems that support the creation, organization, and dissemination of business knowledge to employees and managers throughout a company. Information systems that focus on operational and managerial applications in support of basic business functions such as accounting or marketing are known as *functional business systems.* Finally, *strategic information systems* apply information technology to a firm's products, services, or business processes to help it gain a strategic advantage over its competitors. See Figure 1.11.

It is also important to realize that business applications of information systems in the real world are typically integrated combinations of the several types of information systems just mentioned. That is because conceptual classifications of information systems are designed to emphasize the many different roles of information systems. In practice, these roles are combined into integrated or *cross-functional informational systems* that provide a variety of functions. Thus, most information systems are designed both to produce information and to support decision making for various levels of management and business functions, as well as perform record-keeping and transaction-processing chores. Whenever you analyze an information system, you

Other Categories of Information Systems
• **Expert systems.** Knowledge-based systems that provide expert advice and act as expert consultants to users. Examples: credit application advisor, process monitor, and diagnostic maintenance systems.
• **Knowledge management systems.** Knowledge-based systems that support the creation, organization, and dissemination of business knowledge within the enterprise. Examples: intranet access to best business practices, sales proposal strategies, and customer problem resolution systems.
• **Strategic information systems.** Support operations or management processes that provide a firm with strategic products, services, and capabilities for competitive advantage. Examples: online stock trading, shipment tracking, and e-commerce Web systems.
• **Functional business systems.** Support a variety of operational and managerial applications of the basic business functions of a company. Examples: information systems that support applications in accounting, finance, marketing, operations management, and human resource management.

probably see that it provides information for a variety of managerial levels and business functions. The enterprise resource planning systems discussed in Chapter 8 are examples of information systems that combine virtually all of the processes of an organization into a single system that spans all organizational boundaries. It's like one big information system that runs the whole organization. We will discuss that more later.

MANAGERIAL CHALLENGES OF INFORMATION TECHNOLOGY
LO 1-5
LO 1-7

Figure 1.12 illustrates the scope of the challenges and opportunities facing business managers and professionals in effectively managing information systems and technologies. Success in today's dynamic business environment depends heavily on maximizing the use of Internet-based technologies and Web-enabled information systems to meet the competitive requirements of customers, suppliers, and other business partners in a global marketplace. Figure 1.12 also emphasizes that information systems and their associated technologies must be managed to support the business strategies, business processes, and organizational structures and culture of a business enterprise. That is because information systems are designed, operated, and used by people in a variety of organizational settings and business environments. The goal of many companies today is to maximize their customer and business value by using information technology to help their employees implement cooperative business processes with customers, suppliers, and others.

The Business Enterprise

Strategies/Processes/Structure/Culture

Information Technology

Customer Value Business Value

Business / IT Challenges

- Speed and flexibility requirements of product development, manufacturing, and delivery cycles.
- Reengineering and cross-functional integration of business processes using Internet technologies.
- Integration of e-business and e-commerce into the organization's strategies, processes, structure, and culture.

Business / IT Developments

- Use of the Internet, intranets, extranets, and the Web as the primary IT infrastructure.
- Diffusion of Web technology to internetwork employees, customers, and suppliers.
- Global networked computing, collaboration, and decision support systems.

Business / IT Goals

- Give customers what they want, when and how they want it, at the lowest cost.
- Coordination of manufacturing and business processes with suppliers and customers.
- Marketing channel partnerships with suppliers and distributors.