MANAGEMENT INFORMATION SYSTEMS

WILSON, JAMIE

5051 BU
MANAGEMENT INFORMATION SYSTEMS

Tenth Edition

James A. O’Brien
College of Business Administration
Northern Arizona University

George M. Marakas
KU School of Business
University of Kansas

McGraw-Hill
Irwin
Why study information systems? Why do businesses need information technology? What do you need to know about the use and management of information technologies in business? The introductory chapters of Module I are designed to answer these fundamental questions about the role of information systems in business.

- **Chapter 1: Foundations of Information Systems in Business** presents an overview of the five basic areas of information systems knowledge needed by business professionals, including the conceptual system components and major types of information systems. In addition, trends in information systems and an overview of the managerial challenges associated with information systems are presented.

- **Chapter 2: Competing with Information Technology** introduces fundamental concepts of competitive advantage through information technology and illustrates major strategic applications of information systems.

Completing these chapters will prepare you to move on to study chapters on information technologies (Module II), business applications (Module III), systems development processes (Module IV), and the management challenges of information systems (Module V).
CHAPTER 1

FOUNDATIONS OF INFORMATION SYSTEMS IN BUSINESS

Chapter Highlights

Section I
Foundation Concepts: Information Systems in Business
The Real World of Information Systems
Real World Case: eCourier, Cablecom, and Bryan Cave: Delivering Value Through Business Intelligence
The Fundamental Roles of IS in Business
Trends in Information Systems
The Role of e-Business in Business
Types of Information Systems
Managerial Challenges of Information Technology

Section II
Foundation Concepts: The Components of Information Systems
System Concepts: A Foundation
Real World Case: The New York Times and Boston Scientific: Two Different Ways of Innovating with Information Technology
Components of Information Systems
Information System Resources
Information System Activities
Recognizing Information Systems
Real World Case: Sew What? Inc.: The Role of Information Technology in Small Business Success
Real World Case: JetBlue and the Veterans Administration: The Critical Importance of IT Processes

Learning Objectives

1. Understand the concept of a system and how it relates to information systems.
2. Explain why knowledge of information systems is important for business professionals, and identify five areas of information systems knowledge that they need.
3. Give examples to illustrate how the business applications of information systems can support a firm’s business processes, managerial decision making, and strategies for competitive advantage.
4. Provide examples of several major types of information systems from your experiences with business organizations in the real world.
5. Identify several challenges that a business manager might face in managing the successful and ethical development and use of information technology in a business.
6. Provide examples of the components of real world information systems. Illustrate that in an information system, people use hardware, software, data, and networks as resources to perform input, processing, output, storage, and control activities that transform data resources into information products.
7. Demonstrate familiarity with the myriad of career opportunities in information systems.
SECTION I

Foundation Concepts: Information Systems in Business

The question of why we need to study information systems and information technology has evolved into a moot issue. Information systems have become as integrated into our daily business activities as accounting, finance, operations management, marketing, human resource management, or any other major business function. Information systems and technologies are vital components of successful businesses and organizations—some would say they are business imperatives. They thus constitute an essential field of study in business administration and management, which is why most business majors include a course in information systems. Since you probably intend to be a manager, entrepreneur, or business professional, it is just as important to have a basic understanding of information systems as it is to understand any other functional area in business.

Information technologies, including Internet-based information systems, are playing vital and expanding roles in business. Information technology can help all kinds of businesses improve the efficiency and effectiveness of their business processes, managerial decision making, and workgroup collaboration, which strengthens their competitive positions in rapidly changing marketplaces. This benefit occurs irrespective of whether the information technology is used to support product development teams, customer support processes, e-commerce transactions, or any other business activity. Information technologies and systems are, quite simply, an essential ingredient for business success in today’s dynamic global environment.

Let’s take a moment to bring the real world into our discussion of the importance of information systems (IS) and information technology (IT). See Figure 1.1, and read the Real World Case about using information technology to better understand and satisfy customer needs.

If we are to understand information systems and their functions, we first need to be clear on the concept of a system. In its simplest form, a system is a set of interrelated components, with a clearly defined boundary, working together to achieve a common set of objectives. Using this definition, it becomes easy to see that virtually everything you can think of is a system, and one system can be made up of other systems or be part of a bigger system. We will expand on this concept later in the next section, but for now, this definition gives us a good foundation for understanding the focus of this textbook: information systems.

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 thought of as having something to do 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.
Visitors to the eCourier Web site are greeted with the words “How happy are you? Take the eCourier happy test today!” Those words and the playful purple Web site represent the company’s customer satisfaction focus. And the company achieves that happiness through its focus on operational business intelligence.

Business intelligence is moving out of the ivory tower of specialized analysts and is being brought to the front lines. In the case of eCourier, whose couriers carry 2,000 packages around London each day, operational business intelligence allows the company to keep real-time tabs on customer satisfaction. “This is a crucial differentiator in London’s competitive same-day courier market, where clients are far more likely to take their business elsewhere than they are to report a problem to their current courier,” says the company’s chief technology officer and cofounder Jay Bregman.

Just one online directory, London Online, shows about 350 listings for courier services.

Before implementing operational business intelligence, eCourier sought to define IT as a crucial differentiator. Cofounders Tom Allason, eCourier’s CEO, and Bregman ditched the idea of phone dispatchers and instead gave their couriers GPS-enabled handhelds so that couriers can be tracked and orders can be communicated electronically. They also focused on making online booking easy and rewarding, and much was invested in user-friendly applications: Customers can track online exactly where their courier is, eliminating the package delivery guesswork.

Today, 95 percent of deliveries are booked online; this means that eCourier needs a much smaller staff for monitoring, tracking, and placing orders, which in turn makes the company more scalable. Bregman says this is notable in a market where many courier companies use telephone dispatchers and guesswork about package whereabouts. Booking and tracking automation—although innovative—did not complete the customer happiness puzzle. Without leading-edge business intelligence, account managers could miss the same issues that plagued other courier services—late deliveries, surly couriers, or even an unnoticed ramp-up in deliveries. “We’re only one delivery away from someone deciding to use a different delivery firm,” says Bregman.

So eCourier started to use software from a company called SeeWhy to try to generate customer data more quickly. “What’s unique about SeeWhy,” says Bregman, “is its ability to report what’s happening with customers instantly.” When a new booking enters eCourier’s database, the information is duplicated and saved into a repository within SeeWhy. The software then interprets the data by comparing it with previous information and trends, and if it notices an anomaly, it takes action. If a customer typically places an eCourier order every Thursday morning between 9:30 and 10:00 and there’s been no contact during that time, eCourier’s CRM team will receive an alert shortly after 10:00 that includes the client’s history and the number of bookings it typically places in a day. Bregman says there’s a fair amount of fine-tuning to get the metrics right. For example, the company had to tweak the system to recognize expected shifts in activity so that it doesn’t send a slew of alerts once the after-Christmas drop in business occurs. Getting that perfect balance of when to send alerts and how best to optimize the system is an ongoing process, he says.

The SeeWhy software is designed to establish a “normal” client booking pattern from the first use, which is deepened with each subsequent booking. A sharp drop-off in bookings, an increase in bookings, or a change in dormant account activity generates an alert that is sent to that client’s account manager; the manager uses the opportunity to problem-solve or, in the case of increased activity, upsell to overnight or international services. “These capabilities have provided a big payoff,” says Bregman. He also believes the system saves his company the expense of having to hire people to monitor “who’s happy and who’s not—we’re able to do a lot more on our customer team with a lot less.”

Other approaches to judging customer dissatisfaction exist. Cablecom, a Swiss telecom company, used SPSS’s statistical software to mine customer data, primarily from trouble tickets—such as the average duration of a ticket, or how many tickets had been opened for a customer over a specific time period—to build a model that could flag when a customer was at a high risk of leaving. “But the model proved to be only about 70 percent accurate,” says Federico Cesconi, director of customer insight and retention.

So Cesconi used SPSS’s Dimensions survey research software to create an online customer survey, and from that he was able to determine that customer dissatisfaction usually begins around the ninth month of service, with the bulk of the customer losses occurring between months 12 and 14. Cesconi then created another survey that he now offers to
customers in the seventh month of service, which includes an area where they can type in specific complaints and problems. “Cablecom calls customers within 24 hours of completing the survey,” says Cesconi. “The two approaches together provide the best view of customers ready to bolt, and the best chance at retaining them.”

In 2002, global law firm Bryan Cave faced the million-dollar question: How do you make the most money with your resources while simultaneously delivering the highest customer value? The problem was pressing. Clients of the firm, which now has 800 lawyers in 15 offices worldwide, were demanding alternatives to the traditional hourly fee structure. They wanted new models, such as fixed pricing and pricing that was adjusted during a project.

But making money from these new billing strategies required the complicated balance of staffing and pricing.

Projects weighted too heavily with a law partner’s time would be expensive (for the law firm) and not optimized for profit. Devoting too little of a partner’s time would leave clients feeling undervalued. Optimizing profit and perceived value had to be achieved by spreading partners’ time throughout a number of cases and balancing the remaining resources needed for a case with the less-expensive fees of associates and paralegals. “Clients are most likely to stay with you if you deliver just the right mix,” says Bryan Cave’s CIO John Alber.

The law firm’s traditional method of analyzing collected fees and profit used a spreadsheet that was complicated and took too long. “Spreadsheets provide a level of detail that can be valuable for analysts,” says Alber, “but the information in a spreadsheet can be confusing and difficult to work with.” Alber says he decided it was better to build an easy-to-understand interface using business intelligence tools. Although the company will not release specific figures, both profitability and hours leveraged—the hours worked by equity partners and all other fee earners at the firm—have increased substantially since the company implemented its first BI tool in 2004, according to Alber.

The tools also allow lawyers to track budgets in real time so that they can make adjustments quickly. The BI tools even provide a diversity dashboard, which tracks the hourly mix of women and minorities working on the firm’s cases, a feature the company will license to Redwood Analytics for sale to other law firms. The firm developed this diversity tool to bring transparency to the diversity reporting process required by many clients. In other words, the tools provide Bryan Cave with a method of customizing its fees and helping clients better understand what they get for their money.

As an illustration, Alber points to the customized pricing one lawyer gave to his real estate client. “Developers think in terms of square feet,” says Alber, “and this client couldn’t understand why legal fees for a 400,000-square-foot building might be the same as for a 4,000-square-foot building, though it required the same amount of the lawyer’s time.” So the lawyer used the pricing and staffing modeling tools and historical analysis tools to determine whether it made sense for the law firm to charge clients based on the size of their projects.

He found that while there was risk of underpricing large buildings, the deal volume in small buildings offset that risk for the law firm. The result made per-square-foot pricing possible.

“It may be possible that someone with enough willpower or manpower could do that using traditional analysis,” says Alber, “but this lawyer had the information right at his fingertips.” Business intelligence enables “us to be in touch with clients and shift things around in response to what customers are asking,” says Alber. Adopting new and improved project management, pricing, and customer service capabilities required planning, appropriate pacing, and user buy-in.

“In today’s environment, you can’t do value innovation without being in touch with the economics of your business, without really understanding where you make money and where you don’t, and that’s what business intelligence tools do,” says Alber. “Our goal,” he says, “is to build the best long-term relationships in the world.”


CASE STUDY QUESTIONS

1. How do information technologies contribute to the business success of the companies depicted in the case? Provide an example from each company explaining how the technology implemented led to improved performance.

2. In the case of law firm Bryan Cave discussed above, the use of BI technology to improve the availability, access, and presentation of existing information allowed them to provide tailored and innovative services to their customers. What other professions could benefit from a similar use of these technologies, and how? Develop two different possibilities.

3. Cablecom developed a prediction model to better identify those customers at risk of switching to other company in the near future. In addition to those noted in the case, what other actions could be taken if that information were available? Give some examples of these. Would you consider letting some customers leave anyway? Why?

REAL WORLD ACTIVITIES

1. Use the Internet to research the latest offerings in business intelligence technologies and their uses by companies. What differences can you find with those reviewed in the case? Prepare a report to summarize your findings and highlight new and innovative uses of these technologies.

2. Why do some companies in a given industry, like eCourier above, adopt and deploy innovative technologies while others in the same line of business do not? Break into small groups with your classmates to discuss what characteristics of companies could influence their decision to innovate with the use of information technologies.
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 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-business 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

---

**FIGURE 1.2**
A framework that outlines the major areas of information systems knowledge needed by business professionals.
Module I / Foundation Concepts

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 there are a seemingly endless number of software applications, 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 the fundamental roles interact in a typical organization. At any moment, information systems designed to support business processes and operations may also be providing data to, or accepting data from, systems 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 five days a week out of its distribution center. “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.

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 prespecified information products produced by such 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 managerial end users 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.

**FIGURE 1.4**
The expanding roles of the business applications of information systems. Note how the roles of computer-based information systems have expanded over time. Also, note the impact of these changes on the end users and managers of an organization.
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 either the reports of management information systems or the analytical modeling capabilities of decision support systems, so the concept of executive information systems (EIS) developed. These information systems were created to give top executives an easy way to get 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.

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 even tighter integration, combined with greater flexibility.

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.

Conceptually, the applications of information systems that are implemented in today's business world can be classified in several different ways. For example, several types of information systems can be classified as either 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 roles each plays in the operations and management of a business. Let's look briefly at some examples of such information systems categories.

**Types of Information Systems**

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

**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

---

**FIGURE 1.7** A summary of operations support systems with examples.

<table>
<thead>
<tr>
<th>Operations Support Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transaction processing systems.</strong> Process data resulting from business transactions, update operational databases, and produce business documents. Examples: sales and inventory processing and accounting systems.</td>
</tr>
<tr>
<td><strong>Process control systems.</strong> Monitor and control industrial processes. Examples: petroleum refining, power generation, and steel production systems.</td>
</tr>
<tr>
<td><strong>Enterprise collaboration systems.</strong> Support team, workgroup, and enterprise communications and collaborations. Examples: e-mail, chat, and videoconferencing groupware systems.</td>
</tr>
</tbody>
</table>

---

**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.*
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 support business decision making. Examples: sales analysis, production performance, and cost trend reporting systems.

**Decision support systems (DSS)** give direct computer support to managers during the decision-making process. 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 manufacture the product.

**Executive information systems (EIS)** provide critical information from MIS, DSS, 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.

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. **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 to produce information and 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 probably see that it provides information for a variety of managerial levels and business functions.

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 technologies must be managed to support the business strategies, business processes, and organizational structures and culture of a business enterprise. That is because computer-based information systems, though heavily dependent on information technologies, 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.

Success and Failure with IT

By now you should be able to see that the success of an information system should not be measured only by its **efficiency** in terms of minimizing costs, time, and the use of information resources. Success should also be measured by the **effectiveness** of the information technology in supporting an organization’s business strategies, enabling its business processes, enhancing its organizational structures and culture, and increasing the customer and business value of the enterprise.

It is important to realize, however, that information technology and information systems can be mismanaged and misapplied in such a way that IS performance problems create both technological and business failures. Let’s look at an example of what happens after these failures occur, as well as what can be done to avoid them.

Responsibility and Accountability for Project Success (and Failure)

Your department—information technology—has just played a starring role in blowing a multimillion-dollar enterprise software project. The intense glare from the CEO, CFO and other business leaders is squarely focused on the CIO, VP of applications, project managers and business analysts charged with making sure that this didn’t happen. Of course, IT is never 100 percent at fault for any massive project—whether an ERP or CRM implementation, mainframe migration, or networking upgrade. The business side usually plays its part.
But the unfortunate and unfair fact is that because these initiatives are considered “technology projects,” the business will almost always look in IT’s direction when there’s blame to be tossed around. “That’s just a fact of life in IT,” says Chris Curran, who’s both a consulting partner at Diamond Management & Technology Consultants and its Chief Technology Offer.

No sane executive would dismiss the strategic importance of IT today. And most don’t: An IT Governance Institute study, consisting of more than 250 interviews with executives of both large and small companies in a variety of industry sectors, found that half of the respondents said that IT is “very important to the enterprise,” and three-quarters stated that they align IT and business strategies.

When it came to IT project accountability, “executive management” was identified as the group held accountable for IT governance in 71 percent of the enterprises. That’s all well and good, but when it comes to walking the walk with technology projects, non-IT executives appear to fall back on familiar rhetoric. In a similar 2009 survey of more than 500 IT professionals by ISACA, a nonprofit trade group focusing on corporate governance, almost half of respondents said “the CIO is responsible for ensuring that stakeholder returns on IT-related investments are optimized,” notes the survey report.

Curran takes those results a step further. “Business investments need to have business accountability,” Curran says. “But when a project goes south, especially high-profile ERP implementations, IT gets blamed—but it’s not an IT project.”

Curran’s advice for such massive undertakings, which CIOs and analysts talk up but many don’t follow, is practical: Think bite-sized project chunks and set proper expectations. He also advises his clients and their IT shops to embrace change and transparency—even if it hurts at first. “The corporate culture—the status quo—tends to be: ‘Everything’s good. We don’t talk about problems until they are near unrecoverable, because we know people don’t like bad news,’” Curran says.

But there are always going to be problems. That, also, is “just a fact of life in IT.”


Developing IS Solutions

Developing successful information system solutions to business problems is a major challenge for business managers and professionals today. As a business professional, you will be responsible for proposing or developing new or improved uses of information technologies for your company. As a business manager, you will frequently manage the development efforts of information systems specialists and other business end users.

Most computer-based information systems are conceived, designed, and implemented using some form of systematic development process. Figure 1.13 shows that several major activities must be accomplished and managed in a complete IS development cycle. In this development process, end users and information specialists design information system applications on the basis of an analysis of the business requirements of an organization. Examples of other activities include investigating the economic or technical feasibility of a proposed application, acquiring and learning how to use any software necessary to implement the new system, and making improvements to maintain the business value of a system.

We discuss the details of the information systems development process in Chapters 11 and 12. We will explore many of the business and managerial challenges that arise in developing and implementing new uses of information technology in Chapters 13 and 14. Now let’s look at how a company changed its development practices to deliver the
right functionality to users and become more responsive to their needs. This example emphasizes the importance of tailoring systems development practices to the needs of a business.

Agile Systems Development at Con-Way, Inc.

In the old days, companies could spend months planning a technology project and then months or even years implementing it. Not anymore. Strategies are far more dynamic these days, especially as companies respond to challenging economic times.

When someone has a good idea, it's nice to see it come to fruition right away. At transportation company Con-Way—founded in 1929, with more than 26,000 employees and 2008 revenue of more than $5 billion—almost all good ideas require technology to implement. Yet historically, ideas became cold by the time they made it through IT steering committees, project planning, and design reviews. Then, Con-Way became agile—that is, it adopted Agile development practices.

Using Agile, software development is no longer accomplished through lengthy projects.

Instead, the overall concept of the desired system is defined at a high level up front and then developed in short iterations. An iteration is typically no longer than one month, and the software is released for use after each iteration. As people use the software, they determine which features should be built next, providing a feedback loop that results in building the highest priority functionality. One big change for IT is that with Agile, an implementation date is always impending; team members never feel they are able to relax on a project. Meanwhile, developers, used to having private space, can feel that space is violated resulting from “pair programming,” which has two developers constructing the same piece of code at the same time, and colocation, which has team members sitting as close together as humanly possible.

As for the business users, Agile requires them to take a much more active role throughout the entire process. They must work jointly with IT to determine the priorities for each iteration, and they must provide daily direction to IT on the needs for the functionality being built.

“I made the case for change in IT by explaining how the business would benefit if we delivered the highest priority functionality faster. I also kept reiterating what was in it for them—and there was a lot,” says Jackie Barretta, vice president and CIO of Con-Way, Inc. “At the same time, I made the case for change to the business by preparing a solid ROI that quantified the benefits of increasing the efficiency of
development processes, delivering the right functionality more quickly and reducing the overall amount of work in progress."

The change effort has been worth it: After nine months, Agile is delivering on its promises. The iterative approach to software development is providing a feedback loop that results in building the right functionality. "We no longer have the waste problem that was inherent in the old waterfall method. Agile is creating greater alignment between IT and the business because of the constant, daily interaction and because Agile techniques help IT personnel understand the business better," says Barretta. “However, like anything that's really going to pay off, Agile is a huge change for IT and the user community.”


Challenges and Ethics of IT

As a prospective manager, business professional, or knowledge worker, you will be challenged by the ethical responsibilities generated by the use of information technology. For example, what uses of information technology might be considered improper, irresponsible, or harmful to other people or to society? What is the proper business use of the Internet and an organization’s IT resources? What does it take to be a responsible end user of information technology? How can you protect yourself from computer crime and other risks of information technology? These are some of the questions that outline the ethical dimensions of information systems that we will discuss and illustrate with real world cases throughout this text. Figure 1.14 outlines some of the ethical risks that may arise in the use of several major applications of information technology. The following example illustrates some of the security challenges associated with conducting business over the Internet.

Hannaford Bros.: The Importance of Securing Customer Data

Hannaford Bros. may have started as a fruit and vegetable stand in 1883, but it has expanded from its Maine roots to become an upscale grocer with more than 160 stores throughout Maine, Massachusetts, New Hampshire, upstate New York, and Vermont. In March 2008, the supermarket chain disclosed a data security breach; Hannaford said in a notice to customers posted on its Web site that unknown intruders had accessed its systems and stolen about 4.2 million credit and debit card numbers between December 7 and March 10. The breach affected all of Hannaford’s

FIGURE 1.14 Examples of some of the ethical challenges that must be faced by business managers who implement major applications of information technology.
165 supermarkets in New England and New York, as well as 106 stores operated under the Sweetbay name in Florida and 23 independently owned markets that sell Hannaford products.

In a likely precursor of what was yet to come, two class-action lawsuits were filed against the company within the week. The filers argued that inadequate data security at Hannaford had resulted in the compromise of the personal financial data of consumers, thereby exposing them to the risk of fraud. They also claimed the grocer also appeared not to have disclosed the breach to the public quickly enough after discovering it.

Even though the Hannaford breach is relatively small compared with some other corporate security problems, it is likely to result in renewed calls for stricter regulations to be imposed on companies that fail to protect consumer data. In addition to facing the likelihood of consumer lawsuits, retailers who suffer breaches have to deal with banks and credit unions, which are getting increasingly anxious about having to shell out tens of thousands of dollars to pay for the cost of notifying their customers and reissuing credit and debit cards.

Retailers, on the other hand, have argued that the commissions they pay to card companies on each transaction are supposed to cover fraud-related costs, making any additional payments a double penalty. They also have said that the only reason they store payment card data is because of requirements imposed on them by the major credit card companies.

While the ultimate impact of these and other security breaches may be hard to quantify, it represents one of the most important challenges resulting from the ubiquitous use of electronic transaction processing and telecommunication networks in the modern networked enterprise, and one that is likely to keep growing every day. The security of customer and other sensitive data also represents one of the primary concerns of IT professionals.


Challenges of IT Careers

Both information technology and the myriad of information systems it supports have created interesting, challenging, and lucrative career opportunities for millions of men and women all over the globe. At this point in your life you may still be uncertain about the career path you wish to follow, so learning more about information technology may help you decide if you want to pursue an IT-related career. In recent years, economic downturns have affected all job sectors, including IT. Further, rising labor costs in North America, Canada, and Europe have resulted in a large-scale movement to outsource basic software programming functions to India, the Middle East, and Asia-Pacific countries. Despite this move, employment opportunities in the information systems field are strong, with more new and exciting jobs emerging each day as organizations continue to expand their use of information technology. In addition, these new jobs pose constant human resource management challenges to all organizations because shortages of qualified information systems personnel frequently occur. Dynamic developments in business and information technologies cause constantly changing job requirements in information systems, which will ensure that the long-term job outlook in IT remains both positive and exciting.

Along with the myth that there are no jobs for IS professionals (we will dispel this one below!), another common myth is that IS professionals are computer geeks who live in a cubicle. Once again, nothing could be further from the truth! Today’s IS professional must be highly skilled in communication, dealing with people, and, most of all, articulate in the fundamentals of business. The marketplace is demanding a
business technologist with a big “B” and a big “T.” The world of the IS professional is filled with constant challenge, variety, social interaction, and cutting-edge decision making. No desks and cubicles here. If action is what you are after, then you have found it here.

One major recruiter of IS professionals is the IT industry itself. Thousands of companies develop, manufacture, market, and service computer hardware, software, data, and network products and services. The industry can also provide e-business and e-commerce applications and services, end-user training, or business systems consulting. The biggest need for qualified people, however, comes from the millions of businesses, government agencies, and other organizations that use information technology. They need many types of IS professionals, such as systems analysts, software developers, and network managers to help them plan, develop, implement, and manage today’s Internet-based and Web-enabled business/IT applications.

The accounting industry is a more recent major recruiter of IS professionals. Recent legislation, entitled the Sarbanes-Oxley Act of 2002, required major changes with regard to auditing practices by public accounting firms and internal control processes within publicly held organizations of all sizes and industries. Many of these changes directly affect the IT/IS practices of all parties involved. To facilitate the execution of the covenants of Sarbanes-Oxley, the accounting industry is actively recruiting graduates from accounting programs that have a significant emphasis on IS education. In addition, they are spending equal energy to recruit IS/IT professionals to work within the accounting industry. In either case, the result is a significant increase in demand for graduates with an IS/IT background or emphasis. Figure 1.15 lists just a few of the many career roles available to the modern IT professional.

According to recent reports by the U.S. Department of Labor, computer systems analysts, database administrators, and other managerial-level IS positions are expected to be among the fastest-growing occupations through 2012. Employment of IS professionals is expected to grow more than 36 percent (much higher than average) for all occupations as organizations continue to adopt and integrate increasingly sophisticated technologies. Job increases will be driven by very rapid growth in computer system design and related services, which is projected to be one of the fastest-growing

**FIGURE 1.15**
Careers in IS are as diverse and exciting as the technologies used in them; IS professionals have career opportunities in every business environment and activity throughout the world.

<table>
<thead>
<tr>
<th>Systems Analyst</th>
<th>System Consultant</th>
<th>Business Applications Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Information Officer</td>
<td>Computer Operator</td>
<td>Computer Serviceperson</td>
</tr>
<tr>
<td>Network Administrator</td>
<td>Data Dictionary Specialist</td>
<td>Network Manager</td>
</tr>
<tr>
<td>Database Administrator</td>
<td>Database Analyst</td>
<td>Documentation Specialist</td>
</tr>
<tr>
<td>IS Auditor</td>
<td>End-User Computer Manager</td>
<td>Equipment Manufacturer Representative</td>
</tr>
<tr>
<td>PC Sales Representative</td>
<td>Programmer</td>
<td>Program Librarian</td>
</tr>
<tr>
<td>Project Manager</td>
<td>Records Manager</td>
<td>Hardware Sales Representative</td>
</tr>
<tr>
<td>Scheduling and Control Person</td>
<td>Security Officer</td>
<td>Office Automation Specialist</td>
</tr>
<tr>
<td>Senior Project Leader</td>
<td>Service Sales Representative</td>
<td>Software Sales Representative</td>
</tr>
<tr>
<td>Technical Analyst</td>
<td>Software Quality Evaluator</td>
<td>Technical Writer</td>
</tr>
<tr>
<td>Telecommunications Specialist</td>
<td>Training &amp; Standards Manager</td>
<td>User Interface Specialist</td>
</tr>
</tbody>
</table>
industries in the U.S. economy. In addition, many job openings will arise annually from the need to replace workers who move into managerial positions or other occupations or who leave the labor force. Most important to you, IS/IT graduates generally receive one of the highest starting salaries in the school.

Despite the recent economic downturn among information technology firms, IS professionals still enjoy favorable job prospects. The demand for networking to facilitate sharing information, expanding client/server environments, and the need for specialists to use their knowledge and skills in a problem-solving capacity will be major factors in the rising demand for computer systems analysts, database administrators, and other IS professionals. Moreover, falling prices of computer hardware and software should continue to induce more businesses to expand their computerized operations and integrate new technologies. To maintain a competitive edge and operate more efficiently, firms will keep demanding the services of professionals who are knowledgeable about the latest technologies and can apply them to meet the needs of businesses.

Perhaps the time has come to put a sharper edge on this message: The field of information systems is growing at an increasingly rapid pace, and there is no risk of being unemployed upon graduation! I believe that the concern over a lack of IT/IS-related jobs was fueled by the news media and is now, quite simply, unfounded. Headlines proclaimed the death of IS and the lack of jobs in the United States due to massive outsourcing and offshoring. The jobs that were being sent overseas were real ones, to be sure. They were, however, not the jobs that you or your fellow students were ever going to train for during your stay in college—unless, of course, you aspire to being a faceless voice in a call center. These jobs are service-related jobs that, while vital to the big picture, are not the management level, creative business technologist positions that colleges and universities typically train their students to obtain. The real problem facing the IS field today is the lack of graduates! Students are choosing other professions because they fear low pay and unemployment, whereas recruiters are simultaneously begging for more graduates to feed their voracious appetites for more IS professionals. If you choose to avoid a career in information systems, it should not be because you think there are no jobs, that it does not have to do with people, or that it is no fun. Over the course of this book, we will dispel, with strong evidence, all of these rumors and myths. Let’s start with some facts related to the first one.

The Bureau of Labor Statistics has some compelling evidence in favor of a career in information systems:

**Prospects for qualified computer and information systems managers should be excellent.** Fast-paced occupational growth and the limited supply of technical workers will lead to a wealth of opportunities for qualified individuals. While technical workers remain relatively scarce in the United States, the demand for them continues to rise. This situation was exacerbated by the economic downturn in the early 2000s, when many technical professionals lost their jobs. Since then, many workers have chosen to avoid this work since it is perceived to have poor prospects.

**People with management skills and an understanding of business practices and principles will have excellent opportunities, as companies are increasingly looking to technology to drive their revenue.** (Bureau of Labor Statistics Occupational Outlook Handbook, 2008–2009)

Increasingly, more sophisticated and complex technology is being implemented across all organizations, which will continue to fuel the demand for these computer occupations. The demand for systems analysts continues to grow to help firms maximize their efficiency with available technology. Expansion of e-commerce—doing business on the Internet—and the continuing need to build and maintain databases that store critical information about customers, inventory, and projects are fueling demand for database administrators familiar with the latest technology. Finally, the increasing
importance placed on “cybersecurity”—the protection of electronic information—will result in a need for workers skilled in information security. Let’s take a look at the emerging role of business analysts as liaisons between IT specialists and their business customers.

The Critical Role of Business Analysts

For two decades, the CIO has been viewed as the ultimate broker between the business and technology functions. But while that may be an accurate perception in the executive boardroom, down in the trenches, business analysts (BA) have been the ones tasked with developing business cases for IT application development, in the process smoothing relations among competing parties and moving projects along.

The 21st century business analyst is a liaison, bridge, and diplomat who balances the oftentimes incongruous supply of IT resources and demands of the business. A recent Forrester Research report found that those business analysts who were most successful were the ones who could “communicate, facilitate and analyze.” The business analyst is a hot commodity right now due to business reliance on technology, according to Jim McAssey, a principal at The W Group, a consulting firm. “The global delivery capabilities of technology today make the challenges of successfully bridging the gap between business and IT even harder,” he says.

“Companies typically don’t invest in an IT project without a solid business case,” says Jeff Miller, senior vice president of Atea, an IT staffing and consulting firm.

A good business analyst is able to create a solution to a particular business problem and act as a bridge to the technologists who can make it happen. “Without the BA role, CIOs are at significant risk that their projects will not solve the business problem for which they were intended,” says Miller.

The ideal candidate will have 5 to 10 or more years of experience (preferably in a specific industry), a technical undergraduate degree, and an MBA.

Strong risk assessment, negotiation, and problem resolution skills are key, and hands-on experience is critical. Business analysts must be process-driven and able to see a project through conflict and change, from start to finish. “The BA also must have the ability to learn new processes,” says Miller. “A good BA learns business concepts and can quickly relate them to the specific needs of the project.”

In the end, the more business technology analysts that are working in the business, the better off the CIO and IT function will be—no matter if the business technology analysts are reporting into IT or the business side. That’s because those IT-savvy analysts, who will have a more in-depth understanding of and more expertise in technologies, will “ultimately help the business make better decisions when it comes to its interactions with IT,” contend the Forrester analysts. And “CIOs have new allies in the business.” Salaries range from $45,000 (entry level) to $100,000 (senior business analyst) per year.


The IS Function

The successful management of information systems and technologies presents major challenges to business managers and professionals. Thus, the information systems function represents:

- A major functional area of business equally as important to business success as the functions of accounting, finance, operations management, marketing, and human resource management.
- An important contributor to operational efficiency, employee productivity and morale, and customer service and satisfaction.
• A recognized source of value to the firm.
• A major source of information and support needed to promote effective decision making by managers and business professionals.
• A vital ingredient in developing competitive products and services that give an organization a strategic advantage in the global marketplace.
• A dynamic, rewarding, and challenging career opportunity for millions of men and women.
• A key component of the resources, infrastructure, and capabilities of today's networked business enterprises.
• A strategic resource.
System concepts underlie all business processes, as well as our understanding of information systems and technologies. That's why we need to discuss how generic system concepts apply to business firms and the components and activities of information systems. Understanding system concepts will help you understand many other concepts in the technology, applications, development, and management of information systems that we cover in this text. For example, system concepts help us understand:

- **Technology.** Computer networks are systems of information processing components that use a variety of hardware, software, data management, and telecommunications network technologies.
- **Applications.** E-business and e-commerce applications involve interconnected business information systems.
- **Development.** Developing ways to use information technology in business includes designing the basic components of information systems.
- **Management.** Managing information technology emphasizes the quality, strategic business value, and security of an organization's information systems.

Read the Real World Case about how some companies are turning to IT to help them develop new products and services. We can learn a lot from this case regarding the various ways in which IT can be used to foster innovation. See Figure 1.16.

We have used the term *system* more than 100 times already and will use it thousands more before we are done. It therefore seems reasonable that we focus our attention on exactly what a *system* is. As we discussed at the beginning of the chapter, a system is defined as a set of interrelated components, with a clearly defined boundary, working together to achieve a common set of objectives by accepting inputs and producing outputs in an organized transformation process. Many examples of systems can be found in the physical and biological sciences, in modern technology, and in human society. Thus, we can talk of the physical system of the sun and its planets, the biological system of the human body, the technological system of an oil refinery, and the socioeconomic system of a business organization.

Systems have three basic functions:

- **Input** involves capturing and assembling elements that enter the system to be processed. For example, raw materials, energy, data, and human effort must be secured and organized for processing.
- **Processing** involves transformation processes that convert input into output. Examples are manufacturing processes, the human breathing process, or mathematical calculations.
- **Output** involves transferring elements that have been produced by a transformation process to their ultimate destination. For example, finished products, human services, and management information must be transmitted to their human users.

**Example.** A manufacturing system accepts raw materials as input and produces finished goods as output. An information system is a system that accepts resources (data) as input and processes them into products (information) as output. A business organization is a system in which human and economic resources are transformed by various business processes into goods and services.
Almost everybody has a theory about how to save the U.S. newspaper industry. The only consensus, it seems, is that it needs to change fundamentally or it could all but disappear. At The New York Times, tough times have elevated IT-enabled innovation to the top of the agenda.

A research and development group, created in 2006, operates as a shared service across nearly two dozen newspapers, a radio station, and more than 50 Web sites.

“Our role is to accelerate our entry onto new platforms by identifying opportunities, conceptualizing, and prototyping ideas,” explains Michael Zimbalist, the company’s vice president of R&D.

Zimbalist’s staff of 12 includes experts in rapid prototyping, specialists in areas like mobile or cloud computing and data miners who probe Web site data for insight into what visitors do. They work within a common framework based on idea generation, development, and diffusion throughout the business. Recent projects include prototypes for new display ad concepts, as well as BlackBerry applications for Boston.com and the expert site About.com. The team’s work is intended to supplement and support innovation taking place within the business units. For example, the team is prototyping E-Ink, an emerging display technology; some business units can’t spare the resources to investigate it.

At NYTimes.com, the design and product development group of Marc Frons, CTO of Digital Operations, worked with Zimbalist’s team and Adobe developers on the Times Reader 2.0 application, the next generation, on-screen reading system it developed on the Adobe AIR platform. Frons further encourages forward thinking among his 120-person team with twice-annual innovation contests. Winners receive cash, recognition and the resources to turn their ideas into reality. Typical projects are measured against criteria like revenue potential or journalistic value. R&D projects aren’t. “Since we build software, there’s no huge capital investment up front,” Frons says, “which allows us to experiment. The emphasis is on rapid development.”

Times Widgets, a widget-making platform, was a contest winner, as was the recently launched Times Wire, a near real-time customizable interface for online content. “We’re trying to solve specific problems and think about where the business is going,” Frons says. Frons is focused on enhancing revenue, cutting costs, and increasing efficiency through process improvements and automation.

The New York Times has launched a cool interactive map that shows the most popular Netflix rentals across 12 U.S. metropolitan areas: New York, San Francisco/Bay Area, Boston, Chicago, Washington, Los Angeles, Seattle, Minneapolis, Denver, Atlanta, Dallas, and Miami. If you’re a Netflix junkie and a closet Twilight fan (and you live in a major U.S. city), your rental habits are now on display. To create the map, The New York Times partnered with Netflix. The map is a graphical database of the top 100 most-rented Netflix films of 2009 laid on top of maps. With it you can graphically explore top 2009 Netflix movies based on three criteria: films that were hated or loved by critics, an alphabetical list, and most rented. For example, select most rented, and when you place the mouse over a zip code, a window pops up showing you what the top Netflix rentals are for that specific region.

Some trends are not surprising: The most popular Netflix movie of 2009 was The Curious Case of Benjamin Button, although Slumdog Millionaire and Twilight were both in the top 10. Milk, the story of San Franciscan activist Harvey Milk, was popular in San Francisco and other city centers, but not so much in the suburbs of southern cities (such as Dallas and Atlanta). Mad Men, the 1960s-set drama about advertising execs, was hot in parts of Manhattan and Brooklyn, but not in any other major cities. It barely got mention in Denver and Dallas, and not at all in Miami.

The map does show some interesting trends: Big blockbusters were not as popular in city centers (Wanted and Transformers: Revenge of the Fallen, barely made a splash in the city centers of Manhattan and San Francisco), although this could be due to the fact that a lot of people see blockbusters in movie theaters. Last Chance Harvey, a romantic comedy starring Dustin Hoffman and Emma Thompson, was enjoyed in wealthier suburbs (such as Scarsdale), but not in city centers (such as Manhattan). Tyler Perry’s movies (Tyler Perry’s Madea Goes to Jail and Tyler Perry’s The Family That Preys) were popular in predominantly black neighborhoods.

Much of what has been innovative thus far at The New York Times can be classified as process or product innovation. Typically, a healthy and growing company should be content with focusing 90 to 95 percent of its innovation dollars on process improvements and automation. The emphasis is on rapid development. Frons further encourages forward thinking among his 120-person team with twice-annual innovation contests. Winners receive cash, recognition and the resources to turn their ideas into reality. Typical projects are measured against criteria like revenue potential or journalistic value. R&D projects aren’t. “Since we build software, there’s no huge capital investment up front,” Frons says, “which allows us to experiment. The emphasis is on rapid development.”

Times Widgets, a widget-making platform, was a contest winner, as was the recently launched Times Wire, a near real-time customizable interface for online content. “We’re trying to solve specific problems and think about where the business is going,” Frons says. Frons is focused on enhancing revenue, cutting costs, and increasing efficiency through process improvements and automation.

The New York Times has launched a cool interactive map that shows the most popular Netflix rentals across 12 U.S. metropolitan areas: New York, San Francisco/Bay Area, Boston, Chicago, Washington, Los Angeles, Seattle, Minneapolis, Denver, Atlanta, Dallas, and Miami. If you’re a Netflix junkie and a closet Twilight fan (and you live in a major U.S. city), your rental habits are now on display. To create the map, The New York Times partnered with Netflix. The map is a graphical database of the top 100 most-rented Netflix films of 2009 laid on top of maps. With it you can graphically explore top 2009 Netflix movies based on three criteria: films that were hated or loved by critics, an alphabetical list, and most rented. For example, select most rented, and when you place the mouse over a zip code, a window pops up showing you what the top Netflix rentals are for that specific region.

Some trends are not surprising: The most popular Netflix movie of 2009 was The Curious Case of Benjamin Button, although Slumdog Millionaire and Twilight were both in the top 10. Milk, the story of San Franciscan activist Harvey Milk, was popular in San Francisco and other city centers, but not so much in the suburbs of southern cities (such as Dallas and Atlanta). Mad Men, the 1960s-set drama about advertising execs, was hot in parts of Manhattan and Brooklyn, but not in any other major cities. It barely got mention in Denver and Dallas, and not at all in Miami.

The map shows some interesting trends: Big blockbusters were not as popular in city centers (Wanted and Transformers: Revenge of the Fallen, barely made a splash in the city centers of Manhattan and San Francisco), although this could be due to the fact that a lot of people see blockbusters in movie theaters. Last Chance Harvey, a romantic comedy starring Dustin Hoffman and Emma Thompson, was enjoyed in wealthier suburbs (such as Scarsdale), but not in city centers (such as Manhattan). Tyler Perry’s movies (Tyler Perry’s Madea Goes to Jail and Tyler Perry’s The Family That Preys) were popular in predominantly black neighborhoods.

Much of what has been innovative thus far at The New York Times can be classified as process or product innovation. Typically, a healthy and growing company should be content with focusing 90 to 95 percent of its innovation dollars on such core business innovation and 5 percent or 10 percent on new business models, says Mark Johnson, chairman...
of strategic innovation consultancy Innosight. However, he adds, “The newspaper industry is in so much trouble that business model innovation is more important than ever.”

Now is a good—and bad—time for fostering such innovation. “You’ve got the leadership’s attention you need,” says Johnson. “But it’s harder in the sense that there’s an urgency to fix the financials, and being patient in the way you need to be for a new business model to unfold is a very difficult thing to do.”

The New York Times is focused on experimenting with a number of different initiatives, but Boston Scientific faces a much different challenge: how to foster innovation without risking the disclosure and leakage of very valuable intellectual property. And the company has turned to technology to help find the right mix of access and security.

Boston Scientific wants to tear down barriers that prevent product developers from accessing the research that went into its successful medical devices so that they can create new products faster. But making data too easily accessible could open the way to theft of information potentially worth millions or billions of dollars. It’s a classic corporate data privacy problem.

“The more info you give knowledge workers, the more effective they can be in creating a lot of value for the company,” says Boris Evelson, a principal analyst at Forrester. “This creates disclosure risks—that someone’s going to walk away with the data and give it to a competitor.”

This tension compels the $8 billion company to seek out software that allows the broader engineering community to share knowledge while managing access to product development data, says Jude Currier, cardiovascular knowledge management and innovation practices lead at Boston Scientific. “Active security is the way to address this problem,” Currier says.

That is, regularly monitor who's accessing what, and adjust permissions as business conditions change.

Keeping the pipeline of new stents, pacemakers, and catheters fresh is especially important because heart-related data, says Jude Currier, cardiovascular knowledge management and innovation practices lead at Boston Scientific. “Active security is the way to address this problem,” Currier says.

Although the goal is more openness, not all data stay open forever. For example, as a project gets closer to the patent application stage, access to the data about it is clipped to fewer people, Currier says.

He adds that since installing Goldfire, patent applications are up compared to similar engineering groups that do not use the Goldfire tool. “We have had to educate people that we aren’t throwing security out the window but making valuable knowledge available to the organization,” he says.


CASE STUDY QUESTIONS

1. As stated in the case, The New York Times chose to deploy their innovation support group as a shared service across business units. What do you think this means? What are the advantages of choosing this approach? Are there any disadvantages?

2. Boston Scientific faced the challenge of balancing openness and sharing with security and the need for restricting access to information. How did the use of technology allow the company to achieve both objectives at the same time? What kind of cultural changes were required for this to be possible? Are these more important than the technology-related issues? Develop a few examples to justify your answer.

3. The video rental map developed by The New York Times and Netflix graphically displays movie popularity across neighborhoods from major U.S. cities. How would Netflix use this information to improve their business? Could other companies also take advantage of these data? How? Provide some examples.

REAL WORLD ACTIVITIES

1. The newspaper industry has been facing serious challenges to its viability ever since the Internet made news available online. In addition to those initiatives described in the case, how are The New York Times and other leading newspapers coping with these challenges? What do you think the industry will look like 5 or 10 years from now? Go online to research these issues and prepare a report to share your findings.

2. Go online and search the Internet for other examples of companies using technology to help them innovate and develop new products or services. Break into small groups with your classmates to share your findings and discuss any trends or patterns you see in current uses of technology in this regard.
Feedback and Control

The system concept becomes even more useful by including two additional elements: feedback and control. A system with feedback and control functions is sometimes called a cybernetic system, that is, a self-monitoring, self-regulating system.

- **Feedback** is data about the performance of a system. For example, data about sales performance are feedback to a sales manager. Data about the speed, altitude, attitude, and direction of an aircraft are feedback to the aircraft’s pilot or autopilot.

- **Control** involves monitoring and evaluating feedback to determine whether a system is moving toward the achievement of its goal. The control function then makes the necessary adjustments to a system’s input and processing components to ensure that it produces proper output. For example, a sales manager exercises control when reassigning salespersons to new sales territories after evaluating feedback about their sales performance. An airline pilot, or the aircraft’s autopilot, makes minute adjustments after evaluating the feedback from the instruments to ensure that the plane is exactly where the pilot wants it to be.

**Example.** Figure 1.17 illustrates a familiar example of a self-monitoring, self-regulating, thermostat-controlled heating system found in many homes; it automatically monitors and regulates itself to maintain a desired temperature. Another example is the human body, which can be regarded as a cybernetic system that automatically monitors and adjusts many of its functions, such as temperature, heartbeat, and breathing. A business also has many control activities. For example, computers may monitor and control manufacturing processes, accounting procedures help control financial systems, data entry displays provide control of data entry activities, and sales quotas and sales bonuses attempt to control sales performance.

Other System Characteristics

Figure 1.18 uses a business organization to illustrate the fundamental components of a system, as well as several other system characteristics. Note that a system does not exist in a vacuum; rather, it exists and functions in an environment containing other systems. If a system is one of the components of a larger system, it is a subsystem, and the larger system is its environment.

Several systems may share the same environment. Some of these systems may be connected to one another by means of a shared boundary, or interface. Figure 1.18 also illustrates the concept of an open system, that is, a system that interacts with other systems in its environment. In this diagram, the system exchanges inputs and outputs with its environment. Thus, we could say that it is connected to its environment by input and output interfaces. Finally, a system that has the ability to change itself or its environment to survive is an adaptive system.

**FIGURE 1.17** A common cybernetic system is a home temperature control system. The thermostat accepts the desired room temperature as input and sends voltage to open the gas valve, which fires the furnace. The resulting hot air goes into the room, and the thermometer in the thermostat provides feedback to shut the system down when the desired temperature is reached.
Example. Organizations such as businesses and government agencies are good examples of the systems in society, which is their environment. Society contains a multitude of such systems, including individuals and their social, political, and economic institutions. Organizations themselves consist of many subsystems, such as departments, divisions, process teams, and other workgroups. Organizations are examples of open systems because they interface and interact with other systems in their environment. Finally, organizations are examples of adaptive systems because they can modify themselves to meet the demands of a changing environment.

If we apply our understanding of general system concepts to information systems, it should be easy to see the parallels.

Information systems are made up of interrelated components:

- People, hardware, software, peripherals, and networks.
- They have clearly defined boundaries:
  - Functions, modules, type of application, department, or end-user group.
  - All the interrelated components work together to achieve a common goal by accepting inputs and producing outputs in an organized transformation process:
  - Using raw materials, hiring new people, manufacturing products for sale, and disseminating information to others.
  - Information systems make extensive use of feedback and control to improve their effectiveness:
    - Error messages, dialog boxes, passwords, and user rights management.
Many information systems are designed to change in relation to their environments and are adaptive:

- Intelligent software agents, expert systems, and highly specialized decision support systems.

Information systems are systems just like any other system. Their value to the modern organization, however, is unlike any other system ever created.

We have noted that an information system is a system that accepts data resources as input and processes them into information products as output. How does an information system accomplish this task? What system components and activities are involved?

Figure 1.19 illustrates an information system model that expresses a fundamental conceptual framework for the major components and activities of information systems. An information system depends on the resources of people (end users and IS specialists), hardware (machines and media), software (programs and procedures), data (data and knowledge bases), and networks (communications media and network support) to perform input, processing, output, storage, and control activities that transform data resources into information products.

This information system model highlights the relationships among the components and activities of information systems. It also provides a framework that emphasizes four major concepts that can be applied to all types of information systems:

- People, hardware, software, data, and networks are the five basic resources of information systems.
- People resources include end users and IS specialists, hardware resources consist of machines and media, software resources include both programs and procedures, data resources include data and knowledge bases, and network resources include communications media and networks.
Data resources are transformed by information processing activities into a variety of information products for end users.

Information processing consists of the system activities of input, processing, output, storage, and control.

Our basic IS model shows that an information system consists of five major resources: people, hardware, software, data, and networks. Let’s briefly discuss several basic concepts and examples of the roles these resources play as the fundamental components of information systems. You should be able to recognize these five components at work in any type of information system you encounter in the real world. Figure 1.20 outlines several examples of typical information system resources and products.

**People Resources**

People are the essential ingredient for the successful operation of all information systems. These people resources include end users and IS specialists.

- **End users** (also called users or clients) are people who use an information system or the information it produces. They can be customers, salespersons, engineers, clerks, accountants, or managers and are found at all levels of an organization. In fact, most of us are information system end users. Most end users in business are knowledge workers, that is, people who spend most of their time communicating and collaborating in teams and workgroups and creating, using, and distributing information.

- **IS specialists** are people who develop and operate information systems. They include systems analysts, software developers, system operators, and other managerial, technical, and clerical IS personnel. Briefly, systems analysts design information systems based on the information requirements of end users, software developers create computer programs based on the specifications of systems analysts, and system operators help monitor and operate large computer systems and networks.

**Hardware Resources**

The concept of hardware resources includes all physical devices and materials used in information processing. Specifically, it includes not only machines, such as computers...
and other equipment, but also all data media, that is, tangible objects on which data are recorded, from sheets of paper to magnetic or optical disks. Examples of hardware in computer-based information systems are:

- **Computer systems**, which consist of central processing units containing microprocessors and a variety of interconnected peripheral devices such as printers, scanners, monitors, and so on. Examples are handheld, laptop, tablet, or desktop microcomputer systems, midrange computer systems, and large mainframe computer systems.
- **Computer peripherals**, which are devices such as a keyboard, electronic mouse, trackball, or stylus for the input of data and commands, a video screen or printer for the output of information, and magnetic or optical disk drives for the storage of data resources.

**Software Resources**

The concept of software resources includes all sets of information processing instructions. This generic concept of software includes not only the sets of operating instructions called programs, which direct and control computer hardware, but also the sets of information processing instructions called procedures that people need.

It is important to understand that even information systems that do not use computers have a software resource component. This claim is true even for the information systems of ancient times or the manual and machine-supported information systems still used in the world today. They all require software resources in the form of information processing instructions and procedures to properly capture, process, and disseminate information to their users.

The following are examples of software resources:

- **System software**, such as an operating system program, which controls and supports the operations of a computer system. Microsoft Windows and Unix are two examples of popular computer operating systems.
- **Application software**, which are programs that direct processing for a particular use of computers by end users. Examples are sales analysis, payroll, and word processing programs.
- **Procedures**, which are operating instructions for the people who will use an information system. Examples are instructions for filling out a paper form or using a software package.

**Data Resources**

Data are more than the raw material of information systems. The concept of data resources has been broadened by managers and information systems professionals. They realize that data constitute valuable organizational resources. Thus, you should view data just as you would any organizational resource that must be managed effectively to benefit all stakeholders in an organization.

The concept of data as an organizational resource has resulted in a variety of changes in the modern organization. Data that previously were captured as a result of a common transaction are now stored, processed, and analyzed using sophisticated software applications that can reveal complex relationships among sales, customers, competitors, and markets. In today’s wired world, the data to create a simple list of an organization’s customers are protected with the same energy as the cash in a bank vault. Data are the lifeblood of today’s organizations, and the effective and efficient management of data is considered an integral part of organizational strategy.

Data can take many forms, including traditional alphanumeric data, composed of numbers, letters, and other characters that describe business transactions and other events and entities; text data, consisting of sentences and paragraphs used in written communications; image data, such as graphic shapes and figures or photographic and video images; and audio data, including the human voice and other sounds.
The data resources of information systems are typically organized, stored, and accessed by a variety of data resource management technologies into:

- Databases that hold processed and organized data.
- Knowledge bases that hold knowledge in a variety of forms, such as facts, rules, and case examples about successful business practices.

For example, data about sales transactions may be accumulated, processed, and stored in a Web-enabled sales database that can be accessed for sales analysis reports by managers and marketing professionals. Knowledge bases are used by knowledge management systems and expert systems to share knowledge or give expert advice on specific subjects. We explore these concepts further in subsequent chapters.

Data versus Information. The word data is the plural of datum, though data commonly represents both singular and plural forms. Data are raw facts or observations, typically about physical phenomena or business transactions. For example, a spacecraft launch or the sale of an automobile would generate a lot of data describing those events. More specifically, data are objective measurements of the attributes (the characteristics) of entities (e.g., people, places, things, events).

Example. Business transactions, such as buying a car or an airline ticket, can produce a lot of data. Just think of the hundreds of facts needed to describe the characteristics of the car you want and its financing or the intricate details for even the simplest airline reservation.

People often use the terms data and information interchangeably. However, it is better to view data as raw material resources that are processed into finished information products. Then we can define information as data that have been converted into a meaningful and useful context for specific end users. Thus, data are usually subjected to a value-added process (data processing or information processing) during which (1) their form is aggregated, manipulated, and organized; (2) their content is analyzed and evaluated; and (3) they are placed in a proper context for a human user.

The issue of context is really at the heart of understanding the difference between information and data. Data can be thought of as context independent: A list of numbers or names, by itself, does not provide any understanding of the context in which it was recorded. In fact, the same list could be recorded in a variety of contexts. In contrast, for data to become information, both the context of the data and the perspective of the person accessing the data become essential. The same data may be considered valuable information to one person and completely irrelevant to the next. Just think of data as potentially valuable to all and information as valuable relative to its user.

Example. Names, quantities, and dollar amounts recorded on sales forms represent data about sales transactions. However, a sales manager may not regard these as information. Only after such facts are properly organized and manipulated can meaningful sales information be furnished and specify, for example, the amount of sales by product type, sales territory, or salesperson.

Network Resources

Telecommunications technologies and networks like the Internet, intranets, and extranets are essential to the successful e-business and e-commerce operations of all types of organizations and their computer-based information systems. Telecommunications networks consist of computers, communications processors, and other devices interconnected by communications media and controlled by communications software. The concept of network resources emphasizes that communications technologies and networks are fundamental resource components of all information systems. Network resources include:

- Communications media. Examples include twisted-pair wire, coaxial and fiber-optic cables, and microwave, cellular, and satellite wireless technologies.
Network infrastructure. This generic category emphasizes that many hardware, software, and data technologies are needed to support the operation and use of a communications network. Examples include communications processors, such as modems and inter-network processors, and communications control software, such as network operating systems and Internet browser packages.

Regardless of the type of information system, the same basic information system activities occur. Let’s take a closer look now at each of the basic data or information processing activities. You should be able to recognize input, processing, output, storage, and control activities taking place in any information system you are studying. Figure 1.21 lists business examples that illustrate each of these information system activities.

Input of Data Resources

Data about business transactions and other events must be captured and prepared for processing by the input activity. Input typically takes the form of data entry activities such as recording and editing. End users usually enter data directly into a computer system or record data about transactions on some type of physical medium such as a paper form. This entry includes a variety of editing activities to ensure that they have recorded the data correctly. Once entered, data may be transferred onto a machine-readable medium, such as a magnetic disk, until needed for processing.

For example, data about sales transactions may be recorded on source documents such as paper order forms. (A source document is the original, formal record of a transaction.) Alternatively, salespersons might capture sales data using computer keyboards or optical scanning devices; they are visually prompted to enter data correctly by video displays. This method provides them with a more convenient and efficient user interface, that is, methods of end-user input and output with a computer system. Methods such as optical scanning and displays of menus, prompts, and fill-in-the-blank formats make it easier for end users to enter data correctly into an information system.

Processing of Data into Information

Data are typically subjected to processing activities, such as calculating, comparing, sorting, classifying, and summarizing. These activities organize, analyze, and manipulate data, thus converting them into information for end users. The quality of any data stored in an information system also must be maintained by a continual process of correcting and updating activities.

Example. Data received about a purchase can be (1) added to a running total of sales results, (2) compared to a standard to determine eligibility for a sales discount, (3) sorted in numerical order based on product identification numbers, (4) classified into product categories (e.g., food and nonfood items), (5) summarized to provide a sales manager with information about various product categories, and finally (6) used to update sales records.

Output of Information Products

Information in various forms is transmitted to end users and made available to them in the output activity. The goal of information systems is the production of appropriate information products for end users. Common information products include messages,
reports, forms, and graphic images, which may be provided by video displays, audio responses, paper products, and multimedia. We routinely use the information provided by these products as we work in organizations and live in society. For example, a sales manager may view a video display to check on the performance of a salesperson, accept a computer-produced voice message by telephone, and receive a printout of monthly sales results.

Storage of Data Resources

Storage is a basic system component of information systems. Storage is the information system activity in which data are retained in an organized manner for later use. For example, just as written text material gets organized into words, sentences, paragraphs, and documents, stored data are commonly organized into a variety of data elements and databases. This organization facilitates their later use in processing or retrieval as output when needed by users of a system. Such data elements and databases are discussed further in Chapter 5, Data Resource Management.

Control of System Performance

An important information system activity is the control of system performance. An information system should produce feedback about its input, processing, output, and storage activities. This feedback must be monitored and evaluated to determine whether the system is meeting established performance standards. Then appropriate system activities must be adjusted so that proper information products are produced for end users.

For example, a manager may discover that subtotals of sales amounts in a sales report do not add up to total sales. This conflict might mean that data entry or processing procedures need to be corrected. Then changes would have to be made to ensure that all sales transactions would be properly captured and processed by a sales information system.

Recognizing Information Systems

As a business professional, you should be able to recognize the fundamental components of information systems you encounter in the real world. This demand means that you should be able to identify:

• The people, hardware, software, data, and network resources they use.
• The types of information products they produce.
• The way they perform input, processing, output, storage, and control activities.

This kind of understanding will help you be a better user, developer, and manager of information systems. As we have pointed out in this chapter, this is important to your future success as a manager, entrepreneur, business professional, or modern business technologist.

Summary

- **IS Framework for Business Professionals.** The IS knowledge that a business manager or professional needs to know is illustrated in Figure 1.2 and covered in this chapter and text. This knowledge includes (1) foundation concepts: fundamental behavioral, technical, business, and managerial concepts like system components and functions, or competitive strategies; (2) information technologies: concepts, developments, or management issues regarding hardware, software, data management, networks, and other technologies; (3) business applications: major uses of IT for business processes, operations, decision making, and strategic/competitive advantage; (4) development processes: how end users and IS specialists develop and implement business/IT solutions to problems and opportunities arising in business; and (5) management challenges: how to manage the IS function and IT resources effectively and ethically to achieve top performance and business value in support of the business strategies of the enterprise.
Business Roles of Information Systems. Information systems perform three vital roles in business firms. Business applications of IS support an organization’s business processes and operations, business decision making, and strategic competitive advantage. Major application categories of information systems include operations support systems, such as transaction processing systems, process control systems, and enterprise collaboration systems; and management support systems, such as management information systems, decision support systems, and executive information systems. Other major categories are expert systems, knowledge management systems, strategic information systems, and functional business systems. However, in the real world, most application categories are combined into cross-functional information systems that provide information and support for decision making and also performing operational information processing activities. Refer to Figures 1.7, 1.9, and 1.11 for summaries of the major application categories of information systems.

System Concepts. A system is a group of interrelated components, with a clearly defined boundary, working toward the attainment of a common goal by accepting inputs and producing outputs in an organized transformation process. Feedback is data about the performance of a system. Control is the component that monitors and evaluates feedback and makes any necessary adjustments to the input and processing components to ensure that proper output is produced.

Information System Model. An information system uses the resources of people, hardware, software, data, and networks to perform input, processing, output, storage, and control activities that convert data resources into information products. Data are first collected and converted to a form that is suitable for processing (input). Then the data are manipulated and converted into information (processing), stored for future use (storage), or communicated to their ultimate user (output) according to correct processing procedures (control).

IS Resources and Products. Hardware resources include machines and media used in information processing. Software resources include computerized instructions (programs) and instructions for people (procedures). People resources include information systems specialists and users. Data resources include alphanumeric, text, image, video, audio, and other forms of data. Network resources include communications media and network support. Information products produced by an information system can take a variety of forms, including paper reports, visual displays, multimedia documents, e-messages, graphics images, and audio responses.
Sew What? Inc.: The Role of Information Technology in Small Business Success

What do Sting, Elton John, and Madonna have in common? Besides being international rock stars, they all use theatrical backdrops designed and manufactured by custom drapery maker Sew What? Inc. Based in Rancho Dominguez, California, Sew What? provides custom theatrical draperies and fabrics for stages, concerts, fashion shows, and special events worldwide and has become an industry leader in rock-and-roll staging.

Founded in 1992 by Australian-born Megan Duckett, Sew What? has grown from a tiny kitchen-and-garage operation to a multimillion-dollar enterprise, thanks to Duckett’s never-say-no approach to customer satisfaction. “When I see a problem, I just don’t back down. I find a way to overcome it and I use everybody I know to help me,” she says.

What made it possible for a one-woman business that started in a kitchen to evolve and grow into a multimillion-dollar company with 35 employees? Megan Duckett attributes her success to hard work, quality workmanship, and especially information technology.

Sew What? has enjoyed explosive growth in recent years, reaching $4 million per year in sales by the end of 2006. Company president Duckett credits much of her firm’s rapid growth to its ability to leverage information technology and the Internet to drive sales. “Before we put up our Web site, sewwhatinc.com, our business was almost all local,” says Duckett. “But after launching the Web site three years ago, we now have clients all over the world. In fact, last year our revenue grew 45 percent on the previous year’s sales, and this year we are on target to enjoy a 65 percent increase on 2005 sales. And nearly all that growth came from Web-driven sales.”

Although the company’s Web site may take center stage, managing all the business the site brings in requires a lot of effort behind the scenes. In particular, Duckett relies on a solid IT infrastructure to help keep the company running smoothly. “We are a customer-centric company,” notes Duckett. “It’s critical that we have excellent back-office information technology to manage the business and deliver outstanding service to our customers.”

Sew What? runs most of its business with Intuit’s QuickBooks Enterprise Solutions Manufacturing and Wholesale Edition software and Microsoft’s Windows Server operating system installed on a Dell PowerEdge 860 server, sporting an Intel Xeon processor and 146 gigabytes of disk storage. According to Duckett, “Running our business requires a lot of storage. In addition to customer information and vital operational and financial QuickBooks files, we need to store thousands of drapery and fabric image files, customer instruction document files, and other types of data.” Sew What’s additional computer support includes an older Dell PowerEdge 500 server dedicated to a few smaller applications and a variety of Dell desktop PC systems for employees.

Sew What? started in 1992 as a part-time endeavor, with Duckett cutting and sewing fabric on her kitchen table. She went full time in 1997 and incorporated in 1998. The important role technology plays in running a successful small business hit home when she lost a big contract. The potential client said that without a Web site, her company “lacked credibility.” “Before losing that contract, I thought, ‘I run a sewing business, a cottage craft. I don’t need a Web site,’” she says. Duckett admits she was rather cocky, mainly because she had grown her business “quite well” by word of mouth alone. “I quickly learned the error of that thought process. You can’t have that attitude and stick around,” she acknowledges.

Losing the contract also coincided with a period of low growth between 2001 and 2002. That’s when Duckett decided to embrace technology. Using Microsoft Publisher, she designed and built her own Web site. “You figure things out and learn how to do it yourself when budgets are thin,” she admits.

Duckett kept working to improve the site and make it better for her customers. A year later, feeling that the site needed refreshing, she signed up for a 10-week course in Dreamweaver and again completely rebuilt the site. Yet another Web site reconstruction helped Sew What? grow into a company with customers around the world and a clientele list that includes international rock stars, Gucci, and Rolling Stone magazine.

In 2005, Duckett decided she needed to improve the site’s navigation because “I wanted it to be sleek and to provide a really good customer experience. That was beyond my abilities, so we hired a Web marketing consulting company to build a custom navigation system for the site.”

She worked with the hired guns on branding, search engine optimization, overall design, and site layout. Duckett still provides all the content, including text and images. There’s also a Spanish version of the site, and the professionals tuned up the main site’s search features to include spelling variants for different English-speaking countries. For example, you can search for the American spelling of theater or the British and Australian version, theatre.

The site also lets potential customers review all kinds of color swatches and teaches them how to calculate accurate measurements for their projects; the differences between a scrim, a tormentor, and a traveler curtain; the proper care and feeding of a variety of drapery materials; and a lot more.

While perusing the Dell Web site one day, Duckett saw a news article about the Dell/NFIB Small Business Excellence Award. The National Federation of Independent Businesses (NFIB) and Dell Inc. present this annual prize to one small business in recognition of its innovative use of technology to improve its customers’ experience. The winner receives $10,000 worth of Dell products and services, a lifetime membership to the NFIB, and a day at Dell’s headquarters with Michael Dell and other senior executives.
“The description of the kinds of businesses they were looking for perfectly described Sew What?” Duckett realized. “Everything they were looking for, we’d done, so I decided to enter. My husband [and business partner] laughed and reminded me that I never win anything.” Writing the essay for the contest caused Duckett to reflect on everything she and her employees had achieved over the years: “We got to sit back and feel really proud of ourselves. Just that process was enough to invigorate everyone in our weekly production meetings.”

The contest judges also recognized Megan Duckett’s passionate commitment to customer satisfaction and use of information technology for business success, so they awarded Sew What? the Small Business Excellence Award. Winning the award proved to be a very emotional experience. Looking at the caliber and achievements of the nine other finalists, Duckett figured Sew What? would remain just a top-10 finalist: “I could not believe that a big company like Dell—so entrepreneurial and advanced in every way—would look at our little company and recognize it.”

Like other small business owners, Duckett puts an enormous amount of physical and emotional energy into her work. “Winning this award is so flattering on a personal level,” she says. “This business is ingrained in every cell of my body, and to have someone saying, ‘Good job,’ well, in small business, nobody ever says that to you.”

That may have been true previously, but Sew What’s technology leadership and business success continue to earn recognition. In March 2007, the company received a Stevie Award for Women in Business for “most innovative company of the year” among those with up to 100 employees. A few months earlier, Sew What? had received an SMB 20 Award from PC Magazine, which honors 20 of the most technologically innovative small- and medium-sized businesses (SMBs) each year. “Small and medium businesses drive today’s economy. However, they often don’t get the attention and recognition they deserve,” said PC Magazine’s Editor-in-Chief, Jim Louderback. “We want to highlight the hard work, technological leadership, and innovative spirit of thousands of SMB companies throughout the world.”

Duckett plans to use her prize winnings to add a bar code system that can track the manufacturing process at the company’s warehouse. In the drapery business, fabric is stored on a roll in the warehouse and then moves through different stages: receiving, cutting, sewing, shipping, and so forth. The scanning process will enable Duckett’s team to track how long the fabric stays in any given stage. These data will give them a better idea of their costs, which will then help them produce more accurate price lists.

“We don’t need to charge an hour and a half for labor if the cutting only takes an hour and 15 minutes,” Duckett notes. Currently, the company uses a handwritten system of sign-in and sign-out sheets that, she says, takes too long and introduces too many errors. “The new system will also let us track the progress of individual orders,” she promises. “We’ll be able to provide better service by keeping the customer updated.”


CASE STUDY QUESTIONS

1. How do information technologies contribute to the business success of Sew What? Inc.? Give several examples from the case regarding the business value of information technology that demonstrate this conclusion.

2. If you were a management consultant to Sew What? Inc., what would you advise Megan Duckett to do at this point to be even more successful in her business? What role would information technology play in your proposals? Provide several specific recommendations.

3. How could the use of information technology help a small business you know be more successful? Provide several examples to support your answer.

REAL WORLD ACTIVITIES

1. Search the Internet to help you evaluate the business performance of Sew What? Inc. and its competitors at the present time. What conclusions can you draw from your research about Sew What’s prospects for the future? Report your findings and recommendations for Sew What’s continued business success to the class.

2. Small businesses have been slower to integrate information technology into their operations than larger companies. Break into small groups with your classmates to discuss the reasons for this state of affairs, identifying several possible IT solutions and their business benefits that could help small businesses become more successful.
When most people think of information technology, software and hardware immediately come to mind. While these are certainly important, good IT processes, particularly those that need to kick in during a disaster situation, are also critical. Most important, these need to be in place before, and not after, they are needed. For an example, go back to February 2007, when JetBlue Airways was forced to cancel more than 1,000 flights after an ice storm.

“For one, we didn’t have enough of our home-office employees or crew members trained on our reservation system, so while we were dispatching people to the airports to help, which was great, they weren’t trained to actually use the computer system. So we’re going through a process now where we’re actually training those crew members,” says spokesman Eric Brinker. The discount airline is also in the process of expanding the capabilities of its reservation crew members so they can accept more inbound calls. “We basically maxed out,” Brinker said. “We’re working on a system to be able to automatically notify them better to take phone calls.”

In the middle of the crisis, JetBlue’s IT department developed a database that allowed the airline’s scheduling team to improve multitasking. “They were receiving tons of phone calls from our crew members, and we created a database to enter in the whereabouts of our crew members. Then that information would sync up with the information about the crew members that was in the main system,” Brinker said. “Now, during a weather situation, our flight crews and flight hands can call us and give us the location of where they are, and we can start to rebuild the airline immediately using this tool. We do that by cross-referencing where the crew members say they are versus where the computer says they are, which weren’t always in sync.”

Brinker said the airline had never experienced a full meltdown before, so it hadn’t needed to use this type of database. “The system, which was developed in 24 hours and implemented in the middle of JetBlue’s crisis, has now been implemented as a full-time system,” he said. “It’s a real behind-the-scenes improvement for both our crew members and customers,” he said. JetBlue is also improving the way it communicates with its customers, including pushing out automated flight alerts to customers via e-mail and mobile devices.

Even seemingly smaller and less critical processes can have ramifications of a large magnitude in the interconnected world in which we live. In September 2007, during a hearing by the House Committee on Veterans’ Affairs, lawmakers learned about an unscheduled system failure that took down key applications in 17 Veterans Administration (VA) medical facilities for a day. Dr. Ben Davoren, the director of clinical informatics for the San Francisco VA Medical Center, characterized the outage as “the most significant technological threat to patient safety the VA has ever had.” Yet the shutdown grew from a simple change in management procedure that wasn’t properly followed. The small, undocumented change ended up bringing down the primary patient applications at 17 VA medical centers in northern California.

The breakdown exposed just how challenging it is to effect substantial change in a complex organization the size of the VA Office of Information & Technology (OIT). Begun in October 2005 and originally scheduled to be completed by October 2008, the “reforming” of the IT organization at the VA involved several substantial goals. As part of the reform effort, the VA was to shift local control of IT infrastructure operations to regional data-processing centers.

Historically, each of the 150 or so medical centers run by the VA had its own IT service, its own budget authority, and its own staff, as well as independence with regard to how the IT infrastructure evolved. All of the decisions regarding IT were made between a local IT leadership official and the director of that particular medical center. While that made on-site IT staff responsive to local needs, it made standardization across sites nearly impossible in areas such as security, infrastructure administration and maintenance, and disaster recovery.

On the morning of August 31, 2007, staffers in medical centers around northern California starting their workday quickly discovered that they couldn’t log onto their patient systems. The primary patient applications, Vista and CPRS, had suddenly become unavailable. Vista, which stands for Veterans Health Information Systems and Technology Architecture, is the VA’s system for maintaining electronic health records. CPRS, the Computerized Patient Record System, is a suite of clinical applications that provides an across-the-board view of each veteran’s health record. It includes a real-time order-checking system, a notification system to alert clinicians of significant events, and a clinical reminder system. Without access to Vista, doctors, nurses, and others were unable to pull up patient records.

“There was a lot of attention on the signs and symptoms of the problem and very little attention on what is very often the first step you have in triaging an IT incident, which is, ‘What was the last thing that got changed in this environment?’” Director Eric Raffin said.

The affected medical facilities immediately implemented their local contingency plans, which consist of three levels: the first of those is a fail-over from the Sacramento Data Center to the Denver Data Center, according to Bryan D. Volpp, associate chief of staff and clinical informatics. Volpp assumed that the data center in Sacramento would move into the first level of backup—switching over to the Denver data center. It didn’t happen.

On that day, the Denver site wasn’t touched by the outage at all. The 11 sites running in that region maintained their normal operations throughout the day. So why didn’t Raffin’s team make the decision to fail over to Denver? “What the team in Sacramento wanted to avoid was putting at risk the remaining 11 sites in the Denver environment,
facilities that were still operating with no glitches. The problem could have been software-related,” Raffin says. In that case, the problem may have spread to the VA’s Denver facilities, as well. Since the Sacramento group couldn’t pinpoint the problem, they made a decision not to fail over.

Greg Schulz, senior analyst at The Storage I/O Group, said the main vulnerability with mirroring is exactly what Raffin feared. “If I corrupt my primary copy, then my mirror is corrupted. If I have a copy in St. Louis and a copy in Chicago and they’re replicating in real time, they’re both corrupted, they’re both deleted.” That’s why a point-in-time copy is necessary, Schulz continued. “I have everything I need to get back to that known state.”

According to Volpp, “the disruption severely interfered with our normal operation, particularly with inpatient and outpatient care and pharmacy.” The lack of electronic records prevented residents on their rounds from accessing patient charts to review the prior day’s results or add orders. Nurses couldn’t hand off from one shift to another through instructions or medications, which were usually produced electronically.

Volpp said that within a couple of hours of the outage, “most users began to record their documentation on paper,” including prescriptions, lab orders, consent forms, and vital signs and screenings. Cardiologists couldn’t read EKGs, since those were usually reviewed online, nor could they order, update, or respond to consultations.

In Sacramento, the group finally got a handle on what had transpired to cause the outage. “One team asked for a change to be made by the other team, and the other team made the change,” said Raffin. It involved a network port configuration, but only a small number of people knew about it. More important, said Raffin, “the appropriate change request wasn’t completed.” A procedural issue was at the heart of the problem. “We didn’t have the documentation we should have had,” he said. If that documentation for the port change had existed, Raffin noted, “that would have led us to very quickly provide some event correlation: Look at the clock, look at when the system began to degrade, and then stop and realize what we really needed to do was back those changes out, and the system would have likely restored itself in short order.”

According to Evelyn Hubbert, an analyst at Forrester Research Inc., the outage that struck the VA isn’t uncommon. “They don’t make the front page news because it’s embarrassing.” Then, when something happens, she says, “it’s a complete domino effect. Something goes down, something else goes down. That’s unfortunately typical for many organizations.” Schulz concurred. “You can have all the best software, all the best hardware, the highest availability, you can have the best people,” Schulz said. “However, if you don’t follow best practices, you can render all of that useless.”

1. Eric Brinker of JetBlue noted that the database developed during the crisis had not been needed before because the company had never experienced a meltdown. What are the risks and benefits associated with this approach to IT planning? Provide some examples of each.

2. With hindsight, we now know that the decision made by Eric Raffin of the VA not to fail over to the Denver site was the correct one. However, it involved failing to follow established backup procedures. With the information he had at the time, what other alternatives could he have considered? Develop at least two of them.

3. A small, undocumented change resulted in the collapse of the VA system, largely because of the high interrelationship between its applications. What is the positive side of this high degree of interconnection, and how does this benefit patients? Provide examples from the case to justify your answer.

1. Go online and search for reports on the aftermath of these two incidents. What consequences, financial and otherwise, did the two organizations face? What changes, if any, were implemented as a result of these problems? Prepare a report and present your findings to the class.

2. Search the Internet for examples of problems that companies have had with their IT processes. Break into small groups with your classmates to discuss your findings and what solutions you can propose to help organizations avoid the problems you discovered.
Chapter Highlights

Section I  
Fundamentals of Strategic Advantage  
Strategic IT  
Competitive Strategy Concepts  
Real World Case: How to Win Friends and Influence Business People: Quantify IT Risks and Value  
Strategic Uses of Information Technology  
Building a Customer-Focused Business  
The Value Chain and Strategic IS

Section II  
Using Information Technology for Strategic Advantage  
Strategic Uses of IT  
Reengineering Business Processes  
Real World Case: For Companies Both Big and Small: Running a Business on Smartphones  
Becoming an Agile Company  
Creating a Virtual Company  
Building a Knowledge-Creating Company  
Knowledge Management Systems  
Real World Case: Wachovia and Others: Trading Securities at the Speed of Light  
Real World Case: IT Leaders: Reinventing IT as a Strategic Business Partner

Learning Objectives

1. Identify several basic competitive strategies and explain how they use information technologies to confront the competitive forces faced by a business.
2. Identify several strategic uses of Internet technologies and give examples of how they can help a business gain competitive advantages.
3. Give examples of how business process reengineering frequently involves the strategic use of Internet technologies.
4. Identify the business value of using Internet technologies to become an agile competitor or form a virtual company.
5. Explain how knowledge management systems can help a business gain strategic advantages.
SECTION I  
Fundamentals of Strategic Advantage

Strategic IT

Technology is no longer an afterthought in forming business strategy, but the actual cause and driver.

This chapter will show you that it is important to view information systems as more than a set of technologies that support efficient business operations, workgroup and enterprise collaboration, or effective business decision making. Information technology can change the way businesses compete. You should also view information systems strategically, that is, as vital competitive networks, as a means of organizational renewal, and as a necessary investment in technologies; such technologies help a company adopt strategies and business processes that enable it to reengineer or re-invent itself to survive and succeed in today’s dynamic business environment.

Section I of this chapter introduces fundamental competitive strategy concepts that underlie the strategic use of information systems. Section II then discusses several major strategic applications of information technology used by many companies today.

Read the Real World Case regarding how to quantify the risks (and value) of investing in IT. We can learn a lot about how IT can best be managed to provide superior returns on investment from this case. See Figure 2.1.

In Chapter 1, we emphasized that a major role of information systems applications in business is to provide effective support of a company's strategies for gaining competitive advantage. This strategic role of information systems involves using information technology to develop products, services, and capabilities that give a company major advantages over the competitive forces it faces in the global marketplace.

This role is accomplished through a strategic information architecture: the collection of strategic information systems that supports or shapes the competitive position and strategies of a business enterprise. So a strategic information system can be any kind of information system (e.g., TPS, MIS, and DSS) that uses information technology to help an organization gain a competitive advantage, reduce a competitive disadvantage, or meet other strategic enterprise objectives.

Figure 2.2 illustrates the various competitive forces a business might encounter, as well as the competitive strategies that can be adopted to counteract such forces. It is important to note that the figure suggests that any of the major strategies may be deemed useful against any of the common competitive forces. Although it is rare and unlikely that a single firm would use all strategies simultaneously, each has value in certain circumstances. For now, it is only important that you become familiar with the available strategic approaches. Let us look at several basic concepts that define the role of competitive strategy as it applies to information systems.

How should a business professional think about competitive strategies? How can a business use information systems to apply competitive strategies? Figure 2.2 illustrates an important conceptual framework for understanding forces of competition and the various competitive strategies employed to balance them.

A company can survive and succeed in the long run only if it successfully develops strategies to confront five competitive forces that shape the structure of competition in its industry. In Michael Porter's classic model of competition, any business that wants to survive and succeed must effectively develop and implement strategies to counter (1) the rivalry of competitors within its industry, (2) the threat of new entrants into an industry and its markets, (3) the threat posed by substitute products that might capture market share, (4) the bargaining power of customers, and (5) the bargaining power of suppliers.
IO Tim Schaefer thinks words do matter. When he looked at the words IT used inside Northwestern Mutual Life, he felt that they sent exactly the wrong message about IT’s role in meeting business goals. So, over the last 18 months, these words are out: IT costs, internal customers, IT leaders, alignment, and IT systems. These words are in: IT investments, external customers, business leaders, integration, service levels, and IT assets. In addition, “IT and the business” is now referred to as “our business.” “We came to realize we ourselves were building the wall. We were distinguishing ourselves from the rest of the company,” says Schaefer. “We were somehow different. We had all this special knowledge. So this whole concept of black box, and the gap in the relationship, we came to realize was of our own doing.” As part of a broader change of IT strategy and culture, Schaefer has asked the top 150 leaders in IT to commit to being business leaders, not IT leaders.

Symbolic, semantics, and a whole lot of fuss? Sure—if IT continued to behave exactly the same way it always has. At Northwestern Mutual, a life insurance and investment company with more than $155 billion in assets, IT has not. IT started by working very hard to put a real value on IT assets. Although the process is ongoing, Schaefer says the company now knows it has IT assets worth “somewhere north of $3 billion.” IT can talk about service levels in terms that business units care about: Causing problems in the underwriting process costs $11,000 an hour in lost productivity, and problems that keep the field force from using their client management tools costs $25,000 an hour.

Schaefer’s goal is to get IT systems to be viewed as a business asset, with a value every bit as real as the buildings and land the company owns. Getting there requires a portfolio approach to all of its IT assets. That’s not a project portfolio approach that many IT teams have, but an investment portfolio with the same type of processes the company uses to manage holdings in stocks, bonds, real estate, or private equity. Instead of considering whether to buy, hold, or sell assets, though, the IT asset portfolio assesses IT systems and applications through a framework called TIME: tolerate, invest, migrate, or eliminate.

Putting a value on an IT asset isn’t easy. Northwestern Mutual’s IT team does so by working hand-in-hand with the business units that rely on them. How many more employees would it take to process claims if the software system used for that didn’t exist? What’s the replacement cost? What’s the cost per hour to the business if it goes down? Getting an asset value is only the first step, though. All of these factors go into whether and how to invest more into that asset. “If we don’t do the right things with these $3 billion worth of assets, we’re not going to optimize the value,” Schaefer says.

This asset-and-investment philosophy drives which IT projects the company invests in. Lots of companies have a technology strategy committee to help guide IT spending, as does Northwestern Mutual Life. “We’re transitioning them into an investment management board,” Schaefer says. Northwestern Mutual Life has a number of boards to guide its investment into financial asset classes on behalf of policyholders; these boards set broad strategy to determine the best opportunities for return in those categories. Discussions in the technology strategy committee are moving in the same direction.

From that process, the committee has targeted specific high-return investment opportunities for technology. For example, technology that reduces barriers of time and space is a high-return investment opportunity. For example, technology that reduces barriers of time and space is a high-return investment opportunity. For example, technology that reduces barriers of time and space is a high-return investment opportunity. For example, technology that reduces barriers of time and space is a high-return investment opportunity. For example, technology that reduces barriers of time and space is a high-return investment opportunity. For example, technology that reduces barriers of time and space is a high-return investment opportunity. For example, technology that reduces barriers of time and space is a high-return investment opportunity.
investment has traditionally received the least amount of attention when it comes to risk management.

Since 2003, when the software and equipment components of the U.S. GDP took their largest fall in 15 years, most CEOs have viewed technology as a cost rather than an investment. Although budgets have expanded during the past few years, the growth rates have been modest, and most of the money has gone to fortifying financial systems, whereas front-office systems have ranked the lowest.

Companies, having neglected the customer far too long in their technology investments, are likely to start to feel the effect as frustrated customers go elsewhere. Customers will grow even more frustrated when they deal with clunky corporate systems after years of enjoying tremendous innovation in the consumer technology they use.

The contrast is a direct result of treating technology as a cost. This viewpoint has preserved an older set of technologies that weren’t built for the Internet. Many large enterprises are now realizing that without investment in new systems, no new wave of productivity improvement is possible. The question of how to manage this new wave of investment and keep costs under control, however, is still baffling even the best of them.

The process of risk measurement has been “confounding decision-makers within IT for some time,” Gliedman asserts. As a result, companies rely on weak qualitative analysis that only loosely ties to enterprise-application project outcomes, he says. Gliedman breaks down IT risk factors into two categories: implementation and impact risks. Implementation-based risks relate to areas such as project size (“the larger the project, the higher the level of uncertainty about the outcome”) and the technology and vendor (will they both deliver on the intended benefits?). Impact-based risks include cultural, training, and managerial factors that can all significantly affect any project’s outcome and benefits.

“While the risk analysis cannot on its own point to the best course of action, it can provide the additional shading to management so that the eventual decision is an informed one,” Gliedman notes. “Likewise, expectations can be set properly, avoiding overly rosy ROI projections that will lead to inevitable disappointment.”

Most IT departments today could use help in the ongoing struggle to align IT with the business and vice versa: Business executives are frustrated by application uptime challenges and their significant costs to the company’s bottom line, although IT isn’t fully aware of that. The business side is also not at all excited about long-term enterprise projects; as a consequence of both of these issues, they’re feeling animosity toward IT.

Providing more risk transparency to the Mahogany Row on all IT projects could be a huge win for IT departments right now.

One more thing about the words IT uses. Schaefer and his leadership team made a deliberate choice not to rename the IT department to become the business technology department, even though that’s their mindset. They worried that a name change might sound superficial to the business units; instead, they focused on how they talk about IT every day. The message alone doesn’t mean a thing if the IT team doesn’t act differently, by valuing IT assets and then optimizing them. But the message does matter, because it likely reflects how IT thinks about its role in the business and how business units perceive IT. And it’s critical to help change the culture of the organization.

Schaefer has an advantage in getting the company to think and talk about IT as a financial asset. Assets, investments, and returns are the natural language at Northwestern Mutual, a financial services company. But it is not a stretch for nonfinancial IT organizations to embrace this framework and to put hard values on IT assets.

“Listen to the words you use,” Schaefer advises.

CASE STUDY QUESTIONS

1. By changing the way his group talks about IT investments, CIO Tim Schaefer is trying to change the way the rest of the company sees IT. Why do you think this is necessary? What would be the prevailing mindset about IT in his company, such that he needs to do something about it? Provide some examples of how IT may be regarded in this organization.

2. Chip Gliedman of Forrester Research breaks down IT risks into implementation and impact considerations. Why do you think these are so difficult to manage? What makes IT investments different from investments in other areas of a company?

3. Do you agree with the notion that IT investments can be treated in the same manner as financial investments, and similarly quantified by putting a dollar value to them? Why or why not? Would you answer change depending on the type of IT investment under consideration?

REAL WORLD ACTIVITIES

1. Do you agree with the approach and metrics used by Northwestern Mutual to value their IT investments?

2. Can you think of alternative ways, and how those might stack up against those discussed in the case? Break into small groups with your classmates to discuss the pros and cons of alternative approaches to valuing the impacts of IT in a company.

3. Go online and search for examples of IT projects that have been successful, as well as those that have failed. Make a list of the different factors that seem to influence the outcome of these implementations. Can you group them into the categories discussed in the case? Which seem to be the most important? Prepare a presentation to share your findings.
Competition is a positive characteristic in business, and competitors share a natural, and often healthy, rivalry. This rivalry encourages and sometimes requires a constant effort to gain competitive advantage in the marketplace. This ever-present competitive force requires significant resources on the part of a firm.

Guarding against the threat of new entrants also requires the expenditure of significant organizational resources. Not only do firms need to compete with other firms in the marketplace, but they must also work to create significant barriers to the entry of new competition. This competitive force has always been difficult to manage, but it is even more so today. The Internet has created many ways to enter the marketplace quickly and with relatively low cost. In the Internet world, a firm’s biggest potential competitor may be one that is not yet in the marketplace but could emerge almost overnight.

The threat of substitutes is another competitive force that confronts a business. The effect of this force is apparent almost daily in a wide variety of industries, often at its strongest during periods of rising costs or inflation. When airline prices get too high, people substitute car travel for their vacations. When the cost of steak gets too high, people eat more hamburger and fish. Most products or services have some sort of substitute available to the consumer.

Finally, a business must guard against the often opposing forces of customer and supplier bargaining powers. If customers’ bargaining power gets too strong, they can drive prices to unmanageably low levels or just refuse to buy the product or service. If a key supplier’s bargaining power gets too strong, it can force the price of goods and services to unmanageably high levels or just starve a business by controlling the flow of parts or raw materials essential to the manufacture of a product.

Figure 2.2 also illustrates that businesses can counter the threats of competitive forces that they face by implementing one or more of the five basic competitive strategies.

- **Cost Leadership Strategy.** Becoming a low-cost producer of products and services in the industry or finding ways to help suppliers or customers reduce their costs or increase the costs of competitors.
Differentiation Strategy. Developing ways to differentiate a firm’s products and services from those of its competitors or reduce the differentiation advantages of competitors. This strategy may allow a firm to focus its products or services to give it an advantage in particular segments or niches of a market.

Innovation Strategy. Finding new ways of doing business. This strategy may involve developing unique products and services or entering unique markets or market niches. It may also involve making radical changes to the business processes for producing or distributing products and services that are so different from the way a business has been conducted that they alter the fundamental structure of an industry.

Growth Strategies. Significantly expanding a company’s capacity to produce goods and services, expanding into global markets, diversifying into new products and services, or integrating into related products and services.

Alliance Strategies. Establishing new business linkages and alliances with customers, suppliers, competitors, consultants, and other companies. These linkages may include mergers, acquisitions, joint ventures, formation of virtual companies, or other marketing, manufacturing, or distribution agreements between a business and its trading partners.

One additional point regarding these strategies is that they are not mutually exclusive. An organization may make use of one, some, or all of the strategies in varying degrees to manage the forces of competition. Therefore, a given activity could fall into one or more of the categories of competitive strategy. For example, implementing a system that allows customers to track their orders or shipments online could be considered a form of differentiation if the other competitors in the marketplace do not offer this service. If they do offer the service, however, online order tracking would not serve to differentiate one organization from another.

If an organization offers its online package tracking system in a manner that allows its customers to access shipment information via not only a computer but a mobile phone as well, then such an action could fall into both the differentiation and innovation strategy categories. Think of it this way: Not everything innovative will serve to differentiate one organization from another. Likewise, not everything that serves to differentiate organizations is necessarily viewed as innovative. These types of observations are true for any combination of the competitive strategies, thus making them complementary to each other rather than mutually exclusive.

How can business managers use investments in information technology to support a firm’s competitive strategies? Figure 2.3 answers this question with a summary of the many ways that information technology can help a business implement the five basic competitive strategies. Figure 2.4 provides examples of how specific companies have used strategic information systems to implement each of these five basic strategies for competitive advantage. Note the major use of Internet technologies for e-business and e-commerce applications. In the rest of this chapter, we discuss and provide examples of many strategic uses of information technology.

There are many strategic initiatives available to a firm in addition to the five basic strategies of cost leadership, differentiation, innovation, growth, and alliance. Let’s look at several key strategies that can also be implemented with information technology. They include locking in customers or suppliers, building switching costs, raising barriers to entry, and leveraging investment in information technology.

Investments in information technology can allow a business to lock in customers and suppliers (and lock out competitors) by building valuable new relationships with them. These business relationships can become so valuable to customers or suppliers that they deter them from abandoning a company for its competitors or intimidate...
FIGURE 2.3
A summary of how information technology can be used to implement the five basic competitive strategies. Many companies are using Internet technologies as the foundation for such strategies.

<table>
<thead>
<tr>
<th>Basic Strategies in the Business Use of Information Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lower Costs</strong></td>
</tr>
<tr>
<td>• Use IT to substantially reduce the cost of business processes.</td>
</tr>
<tr>
<td>• Use IT to lower the costs of customers or suppliers.</td>
</tr>
<tr>
<td><strong>Differentiate</strong></td>
</tr>
<tr>
<td>• Develop new IT features to differentiate products and services.</td>
</tr>
<tr>
<td>• Use IT features to reduce the differentiation advantages of competitors.</td>
</tr>
<tr>
<td>• Use IT features to focus products and services at selected market niches.</td>
</tr>
<tr>
<td><strong>Innovate</strong></td>
</tr>
<tr>
<td>• Create new products and services that include IT components.</td>
</tr>
<tr>
<td>• Develop unique new markets or market niches with the help of IT.</td>
</tr>
<tr>
<td>• Make radical changes to business processes with IT that dramatically cut costs; improve quality, efficiency, or customer service; or shorten time to market.</td>
</tr>
<tr>
<td><strong>Promote Growth</strong></td>
</tr>
<tr>
<td>• Use IT to manage regional and global business expansion.</td>
</tr>
<tr>
<td>• Use IT to diversify and integrate into other products and services.</td>
</tr>
<tr>
<td><strong>Develop Alliances</strong></td>
</tr>
<tr>
<td>• Use IT to create virtual organizations of business partners.</td>
</tr>
<tr>
<td>• Develop interenterprise information systems linked by the Internet and extranets that support strategic business relationships with customers, suppliers, subcontractors, and others.</td>
</tr>
</tbody>
</table>

FIGURE 2.4
Examples of how, over time, companies have used information technology to implement five competitive strategies for strategic advantage.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Company</th>
<th>Strategic Use of Information Technology</th>
<th>Business Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Leadership</td>
<td>Dell Computer, Priceline.com, eBay.com</td>
<td>Online build to order, Online seller bidding, Online auctions</td>
<td>Lowest-cost producer, Buyer-set pricing, Auction-set prices</td>
</tr>
<tr>
<td>Differentiation</td>
<td>AVNET Marshall, Moen Inc., Consolidated Freightways</td>
<td>Customer/supplier of e-commerce, Online customer design, Customer online shipment tracking</td>
<td>Increase in market share, Increase in market share, Increase in market share</td>
</tr>
<tr>
<td>Innovation</td>
<td>Charles Schwab &amp; Co., Federal Express, Amazon.com</td>
<td>Online discount stock trading, Online package tracking and flight management, Online full-service customer systems</td>
<td>Market leadership, Market leadership, Market leadership</td>
</tr>
<tr>
<td>Growth</td>
<td>Citicorp, Walmart, Toys ‘R’ Us Inc.</td>
<td>Global intranet, Merchandise ordering by global satellite network, POS inventory tracking</td>
<td>Increase in global market, Market leadership, Market leadership</td>
</tr>
<tr>
<td>Alliance</td>
<td>Walmart/Procter &amp; Gamble, Cisco Systems, Staples Inc. and Partners</td>
<td>Automatic inventory replenishment by supplier, Virtual manufacturing alliances, Online one-stop shopping with partners</td>
<td>Reduced inventory cost/increased sales, Agile market leadership, Increase in market share</td>
</tr>
</tbody>
</table>
them into accepting less profitable business arrangements. Early attempts to use information systems technology in these relationships focused on significantly improving the quality of service to customers and suppliers in a firm’s distribution, marketing, sales, and service activities. More recent projects characterize a move toward more innovative uses of information technology.

A major emphasis in strategic information systems has been to find ways to create switching costs in the relationships between a firm and its customers or suppliers. In other words, investments in information systems technology, such as those mentioned in the Boeing example, can make customers or suppliers dependent on the continued use of innovative, mutually beneficial interenterprise information systems. They then become reluctant to pay the costs in time, money, effort, and inconvenience that it would take to switch to a company’s competitors.

By making investments in information technology to improve its operations or promote innovation, a firm could also raise barriers to entry that would discourage or delay other companies from entering a market. Typically, these barriers increase the amount of investment or the complexity of the technology required to compete in an industry or a market segment. Such actions tend to discourage firms already in the industry and deter external firms from entering the industry.

Investing in information technology enables a firm to build strategic IT capabilities so that they can take advantage of opportunities when they arise. In many cases, this happens when a company invests in advanced computer-based information systems to improve the efficiency of its own business processes. Then, armed with this strategic technology platform, the firm can leverage investment in IT by developing new products and services that would not be possible without a strong IT capability. An important current example is the development of corporate intranets and extranets by many companies, which enables them to leverage their previous investments in Internet browsers, PCs, servers, and client/server networks. Figure 2.5 summarizes the additional strategic uses of IT we have just discussed.

**FIGURE 2.5** Additional ways that information technology can be used to implement competitive strategies.

<table>
<thead>
<tr>
<th>Other Strategic Uses of Information Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Develop interenterprise information systems whose convenience and efficiency create switching costs that lock in customers or suppliers.</td>
</tr>
<tr>
<td>● Make major investments in advanced IT applications that build barriers to entry against industry competitors or outsiders.</td>
</tr>
<tr>
<td>● Include IT components in products and services to make substitution of competing products or services more difficult.</td>
</tr>
<tr>
<td>● Leverage investment in IS people, hardware, software, databases, and networks from operational uses into strategic applications.</td>
</tr>
</tbody>
</table>

Hitting “Ctrl + P” can cost your business more than you think. It certainly did at aerospace giant Boeing. Imaging services—which includes production printing, office printing, faxing, scanning, and related supplies—used to cost the company nearly $150 million annually. The problem, says Earl Beauvais, Boeing’s director of print, plot, and scan services, was that imaging wasn’t centrally controlled, and the company used several vendors. Boeing also owned, operated, and maintained about 32,000 imaging devices. The lack of an enterprise-wide solution meant, among other things, that each department was responsible for purchasing its own toner, paper, and other supplies.

To increase efficiency and reduce cost, Beauvais and his team sought a managed services solution to handle everything from print cartridges to printer upkeep across...
Boeing’s 195 domestic sites and 168 international sites. Beauvais spent 18 months researching and interviewing vendors, who had to show how they would manage the company’s imaging technology needs while providing the greatest efficiency at the best price. He and his team chose a partnership comprising Dell (for maintenance and asset management) and Lexmark (for devices). They picked them in part because Dell had infrastructure in place at Boeing.

To prove the concept, a six-month pilot implementation launched at Boeing’s St. Louis office in May 2007. The St. Louis system included 47 new Lexmark device categories, including printers, copy machines, and scanners. “We replaced the devices because we didn’t want variability of age,” says Beauvais.

The beauty of managed services is that Dell owns the devices and handles maintenance, a key goal for Beauvais.

Boeing saw ROI immediately because Dell’s service contract cost less than its existing agreements. In the end, Boeing saved about 30 percent of its imaging maintenance and supplies costs, and 27 percent of its overall imaging costs annually at locations with the new system. The initiative began rolling out companywide at the end of 2007.

For Boeing, the benefits couldn’t be clearer. Beauvais’s staff can now focus more on other business needs, and the company’s total imaging spending has been reduced to $110 million annually. Both will aid Boeing as it navigates a turbulent economy.


The constant struggle to achieve a measurable competitive advantage in an industry or marketplace occupies a significant portion of an organization’s time and money. Creative and innovative marketing, research and development, and process reengineering, among many other activities, are used to gain that elusive and sometimes indescribable competitive advantage over rival firms.

The term competitive advantage is often used when referring to a firm that is leading an industry in some identifiable way such as sales, revenues, or new products. In fact, the definition of the term suggests a single condition under which competitive advantage can exist: when a firm sustains profits that exceed the average for its industry, the firm is said to possess competitive advantage over its rivals. In other words, competitive advantage is all about profits. Of course, sales, revenues, cost management, and new products all contribute in some way to profits, but unless the contribution results in sustained profits above the average for the industry, no measurable competitive advantage has been achieved. The real problem with a competitive advantage, however, is that it normally doesn’t last very long and is generally not sustainable over the long term. Figure 2.6 illustrates this cycle. Once a firm figures out how to gain an advantage over its competitors (normally through some form of innovation), the competitors figure out how it was done through a process referred to as organizational learning. To combat the competitive advantage, they adopt the same, or some similar, innovation. Once this occurs, everyone in the industry is doing what everyone else is doing; what was once a competitive advantage is now a competitive necessity. Instead of creating an advantage, the strategy or action becomes necessary to compete and do business in the industry. When this happens, someone has to figure out a new way to gain a competitive edge, and the cycle starts all over again.

Every organization is looking for a way to gain competitive advantage, and many have successfully used strategic information systems to help them achieve it. The important point to remember is that no matter how it is achieved, competitive advantage doesn’t last forever. Arie de Geus, head of strategic planning for Royal Dutch Shell, thinks there may be one way to sustain it: “The ability to learn faster than your competitors may be the only sustainable competitive advantage in the future.”
Building a Customer-Focused Business

FIGURE 2.6
The move from innovation to competitive advantage quickly becomes competitive necessity when other firms learn how to respond strategically.

The driving force behind world economic growth has changed from manufacturing volume to improving customer value. As a result, the key success factor for many firms is maximizing customer value.

For many companies, the chief business value of becoming a customer-focused business lies in its ability to help them keep customers loyal, anticipate their future needs, respond to customer concerns, and provide top-quality customer service. This strategic focus on customer value recognizes that quality, rather than price, has become the primary determinant in a customer's perception of value. Companies that consistently offer the best value from the customer's perspective are those that keep track of their customers' individual preferences; keep up with market trends; supply products, services, and information anytime and anywhere; and provide customer services tailored to individual needs. Thus, Internet technologies have created a strategic opportunity for companies, large and small, to offer fast, responsive, high-quality products and services tailored to individual customer preferences.

Internet technologies can make customers the focal point of customer relationship management (CRM) and other e-business applications. In combination, CRM systems and Internet, intranet, and extranet Web sites create new channels for interactive communications within a company, as well as communication with customers, suppliers, business partners, and others in the external environment. Such communications enable continual interaction with customers by most business functions and encourage cross-functional collaboration with customers in product development, marketing, delivery, service, and technical support. We will discuss CRM systems in Chapter 8.

Typically, customers use the Internet to ask questions, lodge complaints, evaluate products, request support, and make and track their purchases. Using the Internet and corporate intranets, specialists in business functions throughout the enterprise can contribute to an effective response. This ability encourages the creation of cross-functional discussion groups and problem-solving teams dedicated to customer involvement, service, and support. Even the Internet and extranet links to suppliers and business partners can be used to enlist them in a way of doing business that ensures the prompt delivery of quality components and services to meet a company's commitments to its customers. This process is how a business demonstrates its focus on customer value.

Figure 2.7 illustrates the interrelationships in a customer-focused business. Intranets, extranets, e-commerce Web sites, and Web-enabled internal business processes
form the invisible IT platform that supports this e-business model. The platform enables the business to focus on targeting the kinds of customers it really wants and “owning” the customer’s total business experience with the company. A successful business streamlines all business processes that affect its customers and develops CRM systems that provide its employees with a complete view of each customer, so they have the information they need to offer their customers top-quality personalized service. A customer-focused business helps its e-commerce customers help themselves while also helping them do their jobs. Finally, a successful business nurtures an online community of customers, employees, and business partners that builds great customer loyalty as it fosters cooperation to provide an outstanding customer experience. Let's review a real-world example.

**Universal Orlando: IT Decisions Driven by Customer Data**

Michelle McKenna is the CIO of Universal Orlando Resort, but she is also a mother of two and the planner of family vacations.

In fact, she thinks of herself first as a theme park customer, second as a senior leader at Universal, and finally as the company’s CIO. “Recently we were brainstorming new events that would bring more Florida residents to our theme parks during off-peak tourist periods. Our in-house marketing group was pitching proposals,
and I offered the idea of a Guitar Hero competition. Everyone loved it. But that idea didn’t come from being a CIO—it came from being a mother of two,” she says.

“Thinking like our customers and focusing on our company’s markets are among the most important ways we can fulfill our responsibility to contribute to informed decision making,” says McKenna. Moving forward, it’s more critical than ever for CIOs to study market trends and find ways to maximize business opportunities.

Universal Orlando is one of many brands in the travel and entertainment industry competing for discretionary dollars spent by consumers on leisure time and vacations. Of course, the competition boils down to a market of one—the individual consumer. People often assume that because of the high volume of guests, the experience at Universal Orlando has to be geared for the masses. But digital technology now enables guests to customize their experience. For example, the new Hollywood Rip Ride RockIt Roller Coaster will allow guests to customize their ride experience by choosing the music that plays around them while on the roller coaster. When the ride ends, guests will be able to edit video footage of that experience into a music video to keep, share with friends, or post online.

Any CIO can take a few steps to get market savvy. Management gets weekly data about what happened in the park and what the spending trends are per guest. CIOs should get copied on any reports like that. They should study them and look for patterns. “Don’t be afraid to ask questions about it; give yourself permission to be a smart (and inquisitive) businessperson. When I first joined the company and asked about market issues, people looked at me and thought, ‘Why did she ask that? It doesn’t have anything to do with technology.’ Over time they realized that I needed to understand our data in order to do my job,” says McKenna.

Knowledge of market data helps Universal Orlando drill down to understand what is really happening in business. For example, trends indicated that annual pass holders—Florida residents, primarily—spend less on food, merchandise, and other items than day-pass guests.

It turned out that some pass holders do spend on par with day guests, particularly when they attend special events, Mardi Gras, and Halloween Horror Nights. “This analysis showed that we needed to segment those annual pass holders more deeply in order to better understand them and market to them. So we are building a new data warehouse and business intelligence tools that will calculate spending by hour and by pass type. The initiative started in IT, and we can find many similar opportunities if we look at market details and ask questions,” McKenna says.

Source: Adapted from Michelle McKenna, “Customer Data Should Drive IT Decisions,” CIO Magazine, June 2, 2008.

Let’s look at another important concept that can help you identify opportunities for strategic information systems. The value chain concept, developed by Michael Porter, is illustrated in Figure 2.8. It views a firm as a series, chain, or network of basic activities that add value to its products and services and thus add a margin of value to both the firm and its customers. In the value chain conceptual framework, some business activities are primary processes; others are support processes. Primary processes are those business activities that are directly related to the manufacture of products or the delivery of services to the customer. In contrast, support processes are those business activities that help support the day-to-day operation of the business and that indirectly contribute to the products or services of the organization. This framework can highlight where competitive strategies can best be applied in a business. So managers and business professionals should try to develop a variety of strategic uses of the Internet and other technologies for those basic processes that add the most value to a company’s products or services and thus to the overall business value of the company.
**FIGURE 2.8** The value chain of a firm. Note the examples of the variety of strategic information systems that can be applied to a firm’s basic business processes for competitive advantage.

**Value Chain Examples**

Figure 2.8 provides examples of how and where information technologies can be applied to basic business processes using the value chain framework. For example, the figure illustrates that collaborative workflow intranets can increase the communications and collaboration required to improve administrative coordination and support services dramatically. An employee benefits intranet can help the human resources management function provide employees with easy, self-service access to their benefits information. Extranets enable a company and its global business partners to use the Web to design products and processes jointly. Finally, e-commerce Web portals can dramatically improve procurement of resources by providing online marketplaces for a firm’s suppliers.

The value chain model in Figure 2.8 also identifies examples of strategic applications of information systems technology to primary business processes. These include automated just-in-time warehousing systems to support inbound logistic processes that involve inventory storage, computer-aided flexible manufacturing systems, as well as online point-of-sale and order processing systems to improve the outbound logistics processes that handle customer orders. Information systems can also support marketing and sales processes by developing an interactive targeted marketing capability on the Internet and the Web. Finally, a coordinated and integrated customer relationship management system can dramatically improve customer service.

Thus, the value chain concept can help you identify where and how to apply the strategic capabilities of information technology. It shows how various types of information technologies might be applied to specific business processes to help a firm gain competitive advantages in the marketplace.
Organizations may view and use information technology in many ways. For example, companies may choose to use information systems strategically, or they may be content to use IT to support efficient everyday operations. If a company emphasized strategic business uses of information technology, its management would view IT as a major competitive differentiator. They would then devise business strategies that use IT to develop products, services, and capabilities that give the company major advantages in the markets in which it competes. In this section, we provide many examples of such strategic business applications of information technology. See Figure 2.9.

Read the Real World Case 2 about using information technology to redesign how a business works. We can learn a lot about the advantages gained through the appropriate use of information technology and mobile communications from this case.

One of the most important implementations of competitive strategies is business process reengineering (BPR), often simply called reengineering. Reengineering is a fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in cost, quality, speed, and service. BPR combines a strategy of promoting business innovation with a strategy of making major improvements to business processes so that a company can become a much stronger and more successful competitor in the marketplace.

However, Figure 2.10 points out that although the potential payback of reengineering is high, so too is its risk of failure and level of disruption to the organizational environment. Making radical changes to business processes to dramatically improve efficiency and effectiveness is not an easy task. For example, many companies have used cross-functional enterprise resource planning (ERP) software to reengineer, automate, and integrate their manufacturing, distribution, finance, and human resource business processes. Although many companies have reported impressive gains with such ERP reengineering projects, many others either have experienced dramatic failures or did not achieve the improvements they sought.

Many companies have found that organizational redesign approaches are an important enabler of reengineering, along with the use of information technology. For example, one common approach is the use of self-directed cross-functional or multi-disciplinary process teams. Employees from several departments or specialties, including engineering, marketing, customer service, and manufacturing, may work as a team on the product development process. Another example is the use of case managers, who handle almost all tasks in a business process instead of splitting tasks among many different specialists.

Information technology plays a major role in reengineering most business processes. The speed, information-processing capabilities, and connectivity of computers and Internet technologies can substantially increase the efficiency of business processes, as well as communications and collaboration among the people responsible for their operation and management. For example, the order management process illustrated in Figure 2.11 is vital to the success of most companies. Many of them are reengineering this process with ERP software and Web-enabled e-business and e-commerce systems, as outlined in Figure 2.12. Let’s take a look at an example.
REAL WORLD CASE

In early 2006, San Antonio, Texas-based CPS Energy, the nation’s largest municipally owned energy provider, was by all accounts riding the road to riches. The company had the highest bond ratings of any such utility provider. Its workforce and customer base in general expressed satisfaction. And most important, it was profitable. In other words, there were no external signs that the company was about to launch a technology program that would redefine the way it did business and reshape its workforce of roughly 4,000.

There weren’t external signs, but for those in the know, including Christopher Barron, CPS Energy’s VP and CIO, it couldn’t have been more clear that a change was imminent—and that the future of the company might depend on it.

“We had a much larger workforce than a business our size maybe should have,” Barron says.

Barron looked at other companies with large mobile workforces like its own, companies like UPS and FedEx, and he saw a huge disparity in the way his business was operating. For instance, specific CPS workers had little or no access to IT systems and resources while they were away from the office or warehouse. They were often required to visit work sites or customer locations to diagnose issues or suggest fixes before reporting to the appropriate departments or parties, which would then initiate the next step of the resolution process. That could mean dispatching additional workers, and the whole ordeal could take days.

“If we kept with the amount of manual labor that it took for us to accomplish that work, we would not be in the position to be competitive in the future,” Barron says. From this realization, the company’s Magellan Program was born.

FIGURE 2.9

Companies of all sizes can benefit from using smartphones to improve their business processes.


For Companies Both Big and Small: Running a Business on Smartphones

The Magellan Program was envisioned by Barron and his colleagues as a better way to mobilize and connect its traditionally siloed workforce to the people and systems they needed to do their jobs. The goals of the program were to extend CPS’s networking infrastructure, build its own secure Wi-Fi networks in offices and warehouses, and deploy smartphones and custom mobile applications to all CPS staffers who didn’t currently have a laptop or other mobile device. For Barron, the first and most significant challenge in deploying smartphones to such a large user base was getting executive buy-in.

“One of our biggest headaches has been, and continues to be, the perception that the technology brings little to the table other than e-mail, and it costs a lot,” Barron says.

“For a CIO to try to eliminate all the resistance from a senior executive might take forever,” Barron says. “So rather than try to get to the execs and mollify all their fears about cost, usage and safety, we’ve gone to specific groups, engineers, line workers, office workers, and because it’s so cheap we’ve been able to give the devices out on ‘experimental basis.’ There’s so much value in these handheld devices and two or three applications that they prove themselves,” he says. “You just have to get them into the hands of the people that actually need to use them in order to demonstrate that.”

Three innovative ways CPS staffers use their smartphones are as digital cameras at work sites, as GPS tracking mechanisms, and as emergency notification receivers. In the past, CPS might have had to dispatch a small group of “generalist” workers to a service call to make sure the correct person was there. Today, a single worker can visit a site, take a photo of a damaged piece of equipment or infrastructure, and then send it back to headquarters or the office.

Then an expert diagnoses the issue and sends along instructions to fix the problem or dispatches the appropriate worker, who is available immediately via voice e-mail and SMS text via smartphone.

“The Magellan Program, through the use of smartphones and other technology, has or will empower all employees, no matter what work they perform, to become part of the greater company’s ‘thought network,’” Barron says. “Each person is now like a node in our network.” The company is also seeing significant gains in supply chain efficiency related to Magellan and the smartphone deployment, he says. For instance, smartphones help speed up the purchase order process, because in the past a specific person or group of people needed to be on-site to approve orders. Now the approvers can be practically anywhere with cellular coverage. The company’s supply chain buyers can also visit warehouses to work with the people who actually order parts, leading to faster order times and more proactive supply chain management overall. In just one year, the time it took to close purchasing and procurement deals decreased by more than 65 percent. Also, inventory levels were reduced by more than $8 million since the Magellan Program began.
In addition, both employee and customer satisfaction levels are up, Barron notes, because staff now have more access to corporate systems and information, and they feel closer to the business. Because CPS can now resolve more customer issues with fewer processes, they’ve reduced the time it takes to complete most service calls, leading to happier customers. In fact, the company received the highest score in J.D. Power and Associates’ 2007 Gas Utility Residential Customer Satisfaction Survey.

The technology, however, is no longer the exclusive purview of large companies with significant IT budgets, at least not anymore. Lloyd’s Construction in Eagan, Minnesota, might not seem as if it needs flashy phone software. The $9-million-a-year demolition and carting company has been run by the same family for the past 24 years. Lloyd’s takes down commercial and residential buildings and then hauls them away. What could be more simple? That is, if wrangling 100 employees, 30 trucks, and more than 400 dumpsters can be called simple. Coordinating those moving parts is crucial to growing the business—and to saving the sanity of Stephanie Lloyd, 41, who has run the company for the past four years. Until recently, Lloyd’s used a hodgepodge of spreadsheets, paper ledgers, and accounting software on company PCs to keep track of its workers and equipment. To make matters worse, the company used radios to coordinate with its workers on the job. The more cell phone towers that came online in Minnesota, the worse Lloyd’s radio reception got. It was time, the Lloyds decided, to drag their company into the 21st-century world of smartphones.

Lloyd’s considered a half-dozen mobile-productivity software suites before settling on eTrace, which happened to come from a company called GearWorks based just across town. Not only was GearWorks local, but its software worked on Sprint Nextel’s i560 and i850 phones, which are aimed at the construction industry. Lloyd’s had already started buying these push-to-talk phones to weaken workers from their dying radios. Immediately, technophobic staff had trouble. Employees had to be guided up a steep learning curve in order to master even basic features on their new phones. For 18 months, the two systems ran side by side: eTrace as it was phased in, and the old paper-and-pencil system as it was phased out. Accounting inconsistencies quickly crept in.

And eTrace gave rise to a delicate labor problem. The software featured integrated mapping and travel data that showed the real-time locations of all company assets. To their chagrin, the Lloyds discovered that those assets were spending too much time parked outside the same lunch spots—ones that were not on prescribed routes. Lloyd was sympathetic to workers’ needs for breaks—“we’ve all worked demolition here,” she says—but quickly clamped down on unauthorized ones.

GearWorks’ CEO says the challenges Lloyd’s faced are to be expected. “All these products operate under the ominous pendulum of challenge and opportunity,” says Todd Krautkremer, 47. “But our software does a good job of letting the customer control that rate of change in the business.”

Once the deployment dust had settled, the savings became clear. The company employs 12 drivers, 22 foremen, and 7 office workers who use 41 phones running eTrace. “The company buys an unlimited data package for each phone, which totals about $4,000 a month. Add other networking charges, and Lloyd’s spends about $50,000 a year for a complete business, accounting, and communications solution. Before eTrace, the company paid an accountant 40 hours a week to do the books. Now that person comes in one day a week for 6 hours, saving roughly $1,000 a week.

Data entry and job logging by the dispatcher and foremen, Lloyd says, is roughly 1½ times faster than paper and radio. More efficient routing has cut fuel costs by about 30 percent. And employees have stopped making unauthorized stops. Lloyd estimates a net improvement in performance of 10–12 percent, or roughly $1 million for 2007—not a bad return on $50,000.

“It really does work,” she says.


CASE STUDY QUESTIONS

1. In which ways do smartphones help these companies be more profitable? To what extent are improvements in performance coming from revenue increases or cost reductions? Provide several examples from the case.

2. The companies described in the case encountered a fair amount of resistance from employees when introducing smartphone technologies. Why do you think this happened? What could companies do to improve the reception of these initiatives? Develop two alternative propositions.

3. CPS Energy and Lloyd’s Construction used smartphones to make existing processes more efficient. How could they have used the technology to create new products and services for their customers? Include at least one recommendation for each organization.

REAL WORLD ACTIVITIES

1. In addition to the companies featured in the case, others like FedEx and UPS, which have large mobile workforces, heavily use mobile communication technologies. What other companies could benefit from these innovations?

2. Go online and research uses of smartphones in industries different from the ones reviewed here. Prepare a report to share your findings.

3. Use the Internet to research the latest technological developments in smartphones, and discuss how those could be used by companies to deliver value to customers and shareholders.
FIGURE 2.10
Some of the key ways that business process reengineering differs from business improvement.

<table>
<thead>
<tr>
<th></th>
<th>Business Improvement</th>
<th>Business Process Reengineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Change</td>
<td>Incremental</td>
<td>Radical</td>
</tr>
<tr>
<td>Process Change</td>
<td>Improved new version of process</td>
<td>Brand-new process</td>
</tr>
<tr>
<td>Starting Point</td>
<td>Existing processes</td>
<td>Clean slate</td>
</tr>
<tr>
<td>Frequency of Change</td>
<td>One-time or continuous</td>
<td>Periodic one-time change</td>
</tr>
<tr>
<td>Time Required</td>
<td>Short</td>
<td>Long</td>
</tr>
<tr>
<td>Typical Scope</td>
<td>Narrow, within functions</td>
<td>Broad, cross-functional</td>
</tr>
<tr>
<td>Horizon</td>
<td>Past and present</td>
<td>Future</td>
</tr>
<tr>
<td>Participation</td>
<td>Bottom-up</td>
<td>Top-down</td>
</tr>
<tr>
<td>Path to Execution</td>
<td>Cultural</td>
<td>Cultural, structural</td>
</tr>
<tr>
<td>Execution</td>
<td>Structural</td>
<td></td>
</tr>
<tr>
<td>Primary Enabler</td>
<td>Statistical control</td>
<td>Information technology</td>
</tr>
<tr>
<td>Risk</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>


FIGURE 2.11
The order management process consists of several business processes and crosses the boundaries of traditional business functions.

FIGURE 2.12
Examples of information technologies that support reengineering the order management processes.

- Customer relationship management systems using corporate intranets and the Internet.
- Supplier-managed inventory systems using the Internet and extranets.
- Customer-accessible e-commerce Web sites for order entry, status checking, payment, and service.
- Customer, product, and order status databases accessed via intranets and extranets by employees and suppliers.
We are changing from a competitive environment in which mass-market products and services were standardized, long-lived, information-poor, and exchanged in one-time transactions, to an environment in which companies compete globally with niche market products and services that are individualized, short-lived, information-rich, and exchanged on an ongoing basis with customers.
To be an agile company, a business must use four basic strategies. First, the business must ensure that customers perceive the products or services of an agile company as solutions to their individual problems. Thus, it can price products on the basis of their value as solutions, rather than their cost to produce. Second, an agile company cooperates with customers, suppliers, other companies, and even with its competitors. This cooperation allows a business to bring products to market as rapidly and cost-effectively as possible, no matter where resources are located or who owns them. Third, an agile company organizes so that it thrives on change and uncertainty. It uses flexible organizational structures keyed to the requirements of different and constantly changing customer opportunities. Fourth, an agile company leverages the impact of its people and the knowledge they possess. By nurturing an entrepreneurial spirit, an agile company provides powerful incentives for employee responsibility, adaptability, and innovation.

Figure 2.13 summarizes another useful way to think about agility in business. This framework emphasizes the roles that customers, business partners, and information technology can play in developing and maintaining the strategic agility of a company. Notice how information technology can enable a company to develop relationships with its customers in virtual communities that help it be an agile innovator. As we will see repeatedly throughout this textbook, information technologies enable a company to partner with its suppliers, distributors, contract manufacturers, and others via collaborative portals and other Web-based supply chain systems that significantly improve its agility in exploiting innovative business opportunities.

**FIGURE 2.13** How information technology can help a company be an agile competitor, with the help of customers and business partners.

<table>
<thead>
<tr>
<th>Type of Agility</th>
<th>Description</th>
<th>Role of IT</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>Ability to co-opt customers in the exploitation of innovation opportunities</td>
<td>Technologies for building and enhancing virtual customer communities for product design, feedback, and testing</td>
<td>eBay customers are its de facto product development team because they post an average of 10,000 messages each week to share tips, point out glitches, and lobby for changes</td>
</tr>
<tr>
<td>Partnering</td>
<td>Ability to leverage assets, knowledge, and competencies of suppliers, distributors, contract manufacturers, and logistics providers in the exploration and exploitation of innovation opportunities</td>
<td>Technologies facilitating interfirm collaboration, such as collaborative platforms and portals, supply chain systems</td>
<td>Yahoo! has accomplished a significant transformation of its service from a search engine into a portal by initiating numerous partnerships to provide content and other media-related services from its Web site</td>
</tr>
<tr>
<td>Operational</td>
<td>Ability to accomplish speed, accuracy, and cost economy in the exploitation of innovation opportunities</td>
<td>Technologies for modularization and integration of business processes</td>
<td>Ingram Micro, a global wholesaler, has deployed an integrated trading system allowing its customers and suppliers to connect directly to its procurement and ERP systems</td>
</tr>
</tbody>
</table>

FIGURE 2.14 A virtual company uses the Internet, intranets, and extranets to form virtual workgroups and support alliances with business partners.

In today's dynamic global business environment, forming a virtual company can be one of the most important strategic uses of information technology. A virtual company (also called a virtual corporation or virtual organization) is an organization that uses information technology to link people, organizations, assets, and ideas.

Figure 2.14 illustrates that virtual companies typically form virtual workgroups and alliances with business partners that are interlinked by the Internet, intranets, and extranets. Notice that this company has organized internally into clusters of process and cross-functional teams linked by intranets. It has also developed alliances and extranet links that form interenterprise information systems with suppliers, customers, subcontractors, and competitors. Thus, virtual companies create flexible and adaptable virtual workgroups and alliances keyed to exploit fast-changing business opportunities.

Virtual Company Strategies

Why do people form virtual companies? It is the best way to implement key business strategies and alliances that promise to ensure success in today's turbulent business climate. Several major reasons for virtual companies stand out and are summarized in Figure 2.15.

For example, a business may not have the time or resources to develop the necessary manufacturing and distribution infrastructure, personnel competencies, and information technologies to take full advantage of a new market opportunity in a timely manner. It can assemble the components it needs to provide a world-class solution for customers and capture the market opportunity only by quickly forming a virtual company through a strategic alliance of all-star partners. Today, of course, the Internet, intranets, extranets, and a variety of other Internet technologies are vital components in creating such successful solutions.
In-house technology is no longer an operational prerequisite, thanks to outsourcing. Software, servers, Internet connectivity, and even whole operations like payroll and HR can be sourced from third parties and branded, so neither the customers nor employees of the business need ever know these mechanisms reside outside the company headquarters.

That being said, the fact that the United Kingdom’s rail information service, National Rail Enquiries (NRE), served 55 million customers online last year alone—it relies on extensive self-service and contact center service channels, but has a core staff of only 21 people—is no small achievement. “NRE has about 22 suppliers of various services. Everything we do is outsourced. We have 1,500 people in call centers alone, who all work for NRE,” says Chris Scoggins, NRE’s CEO. The NRE’s telephone information service was born of the creation of the organization in 1996 with the privatization of British Rail. Since then, it has expanded to include automated telephone services and a very successful real-time online train time and journey planning service.

Scoggins says NRE has a strategy of maintaining a number of suppliers to play them off against each other and raise the stakes in terms of demonstrating service excellence. “We have the maximum number of suppliers we can manage effectively. But also, and perhaps more importantly, we need the right number of suppliers to maintain a competitive market for the services they run. In some areas, we have a strategy to build up a number of niche players in the market; otherwise we are relying on one supplier.”

“What we’re trying to do is move toward a number of long-term relationships with partners we trust and give more work to them,” Scoggins says. “Contracts are aligned to incentives related to achieving our business objectives, and it’s up to the supplier to outperform the minimum standard. If they demonstrate they can deliver over and above that, then they get more work.” Despite heading up a vast, virtual company, Scoggins says there is still pressure to drive business improvement and success. “When I joined there was no real self-service provision for the customer. NRE was a very big, outsourced call center with virtually no other provision for finding information. I saw this as a huge opportunity driven by two things. The first was that customer needs should be met by whichever channel is most convenient for them; the second was our call centers, which have the most volatile volumes in Europe.”

NRE is always seeking to be proactive and do new things, like the speech recognition technology they use with their telephone TrainTracker service. “It is the most sophisticated mass-market speech recognition service in the world,” notes Scoggins. He adds, “I regard our outsourcing suppliers as part of our team, and my job is getting my team excited and encouraged to do the job in hand.”

In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge. When markets shift, technologies proliferate, competitors multiply, and products become obsolete almost overnight, successful companies are those that consistently create new knowledge, disseminate it widely throughout the organization, and quickly embody it in new technologies and products. These activities define the “knowledge-creating” company, whose sole business is continuous innovation.

Many companies today can only realize lasting competitive advantage if they become knowledge-creating companies or learning organizations. That means consistently creating new business knowledge, disseminating it widely throughout the company, and quickly building the new knowledge into their products and services.

**Knowledge-creating companies** exploit two kinds of knowledge. One is *explicit knowledge*, which is the data, documents, and things written down or stored on computers. The other kind is *tacit knowledge*, or the “how-tos” of knowledge, which resides in workers. Tacit knowledge can often represent some of the most important information within an organization. Long-time employees of a company often “know” many things about how to manufacture a product, deliver the service, deal with a particular vendor, or operate an essential piece of equipment. This tacit knowledge is not recorded or codified anywhere because it has evolved in the employee’s mind through years of experience. Furthermore, much of this tacit knowledge is never shared with anyone who might be in a position to record it in a more formal way because there is often little incentive to do so or simply, “Nobody ever asked.”

As illustrated in Figure 2.16, successful knowledge management creates techniques, technologies, systems, and rewards for getting employees to share what they know and make better use of accumulated workplace and enterprise knowledge. In that way, employees of a company are leveraging knowledge as they do their jobs.

**Making personal knowledge available to others is the central activity of the knowledge-creating company. It takes place continuously and at all levels of the organization.**

Knowledge management has thus become one of the major strategic uses of information technology. Many companies are building **knowledge management systems** (KMS) to manage organizational learning and business know-how. The goal of such systems is to help knowledge workers create, organize, and make available important business knowledge, wherever and whenever it’s needed in an organization. This information includes processes, procedures, patents, reference works, formulas, best practices, and more.

![Diagram of knowledge management systems](image-url)

**FIGURE 2.16**

Knowledge management can be viewed as three levels of techniques, technologies, and systems that promote the collection, organization, access, sharing, and use of workplace and enterprise knowledge.
practices, forecasts, and fixes. As you will see in Chapter 10, Internet and intranet Web sites, groupware, data mining, knowledge bases, and online discussion groups are some of the key technologies that may be used by a KMS.

Knowledge management systems also facilitate organizational learning and knowledge creation. They are designed to provide rapid feedback to knowledge workers, encourage behavior changes by employees, and significantly improve business performance. As the organizational learning process continues and its knowledge base expands, the knowledge-creating company works to integrate its knowledge into its business processes, products, and services. This integration helps the company become a more innovative and agile provider of high-quality products and customer services, as well as a formidable competitor in the marketplace. Now let's close this chapter with an example of knowledge management strategies from the real world.

If anyone knows that time is money, it's an attorney. The 850 attorneys and their staff at Goodwin Procter LLP were spending too much time assembling documents and looking up information, which meant cases took more time than they should to proceed.

The $611 million law firm's eight offices used seven different applications to manage more than 2 terabytes of data for Goodwin Procter's more than 60,000 cases—close to 10 million documents. CIO Peter Lane wanted to integrate the data. Using Microsoft SharePoint, his team created the Matter Page System as a hub through which attorneys could access business data and client information.

What's more, the firm has been able to use the platform to share its notes and work in progress. It's now easy for an attorney to find a colleague who can help with a similar case. Matter Pages took a year to implement, but it immediately changed how Goodwin Procter's attorneys work.

When a client called with a question, finding the answer used to mean launching more than one application and looking up the data in different systems. Attorneys needed contact information, documents, billing information, and more.

The process sometimes took hours.

"Now, instead of having to launch the different systems from the desktop, or the web interface, or the document management system, we were able to pull all of this information into a one-stop-shop view for the users in our company," says Andrew Kawa, Goodwin Procter's development manager, who leads its system development efforts.

The system increases efficiency for the attorneys because they can find previous matters that they or others have worked on and gain extra information much more quickly than before. They spend less time researching and more time moving a case forward.

Matter Pages' initial success has Lane investigating new SharePoint features, such as wikis and blogs. He expects to deploy these new capabilities widely over the next few months.

For example, each matter has a wiki that is used to track notes, or other unstructured data that relates to it. These notes are open for editing by all users. Blogs tend to be used for discussions that are not case-specific, although when a matter or set of matters apply to the topic of the blog, users can add links to related cases.

"One of the IT goals is to take advantage of the new technology as it becomes available," Lane adds. With that goal in mind, says Lane, the Matter Page System won't ever truly be completed. Currently, Kawa is looking to integrate Goodwin Procter's patent and trademark information with data about their patent applications from the U.S. Patent and Trademark Office. The integration would allow attorneys to retrieve real-time information on their pending patents and actions they need to take.

"I don't think we will ever declare the project done or say we don't have to put any more time or effort in," he says.

Source: Adapted from Jarina D'Auria, "Goodwin Procter Makes Strong Case for Knowledge Management," CIO.com, August 1, 2008.
Module I / Foundation Concepts

**Summary**

- **Strategic Uses of Information Technology.** Information technologies can support many competitive strategies. They can help a business cut costs, differentiate and innovate in its products and services, promote growth, develop alliances, lock in customers and suppliers, create switching costs, raise barriers to entry, and leverage its investment in IT resources. Thus, information technology can help a business gain a competitive advantage in its relationships with customers, suppliers, competitors, new entrants, and producers of substitute products. Refer to Figures 2.3 and 2.5 for summaries of the uses of information technology for strategic advantage.

- **Building a Customer-Focused Business.** A key strategic use of Internet technologies is to build a company that develops its business value by making customer value its strategic focus. Customer-focused companies use Internet, intranet, and extranet e-commerce Web sites and services to keep track of their customers' preferences; to supply products, services, and information anytime or anywhere; and to provide services tailored to the individual needs of the customers.

- **Reengineering Business Processes.** Information technology is a key ingredient in reengineering business operations because it enables radical changes to business processes that dramatically improve their efficiency and effectiveness. Internet technologies can play a major role in supporting innovative changes in the design of workflows, job requirements, and organizational structures in a company.

- **Becoming an Agile Company.** A business can use information technology to help it become an agile company. Then it can prosper in rapidly changing markets with broad product ranges and short model lifetimes in which it must process orders in arbitrary lot sizes; it can also offer its customers customized products while it maintains high volumes of production. An agile company depends heavily on Internet technologies to help it respond to its customers with customized solutions, and to cooperate with its customers, suppliers, and other businesses to bring products to market as rapidly and cost effectively as possible.

- **Creating a Virtual Company.** Forming virtual companies has become an important competitive strategy in today's dynamic global markets. Internet and other information technologies play a key role in providing computing and telecommunications resources to support the communications, coordination, and information flows needed. Managers of a virtual company depend on IT to help them manage a network of people, knowledge, financial, and physical resources provided by many business partners to take advantage of rapidly changing market opportunities.

- **Building a Knowledge-Creating Company.** Lasting competitive advantage today can only come from the innovative use and management of organizational knowledge by knowledge-creating companies and learning organizations. Internet technologies are widely used in knowledge management systems to support the creation and dissemination of business knowledge and its integration into new products, services, and business processes.

**Key Terms and Concepts**

These are the key terms and concepts of this chapter. The page number of their first explanation is in parentheses.

1. Agile company (63)
2. Business process reengineering (58)
3. Competitive forces (46)
4. Competitive strategies (49)
5. Create switching costs (52)
6. Customer value (54)
7. Interenterprise information systems (64)
8. Knowledge-creating company (66)
9. Knowledge management system (66)
10. Leverage investment in IT (52)
11. Lock in customers and suppliers (50)
12. Raise barriers to entry (52)
13. Strategic information systems (46)
14. Value chain (56)
15. Virtual company (64)

**Review Quiz**

Match one of the key terms and concepts listed previously with one of the brief examples or definitions that follow. Try to find the best fit for answers that seem to fit more than one term or concept. Defend your choices.

1. A business must deal with customers, suppliers, competitors, new entrants, and substitutes.
2. Cost leadership, differentiation of products, and new product innovation are examples.
3. Using investments in technology to keep firms out of an industry.
4. Making it unattractive for a firm's customers or suppliers to switch to its competitors.
S

curities trading is one of the few business activities where a one-second processing delay can cost a company big bucks. Wachovia Corporate and Investment Bank is addressing the growing competitive push toward instantaneous trading with a comprehensive systems overhaul. In a project that has cost more than $10 million so far, Wachovia is tearing down its systems silos and replacing them with an infrastructure that stretches seamlessly across the firm’s many investment products and business functions.

“Competitive advantage comes from your math, your workflow and your processes through your systems. Straight-through processing is the utopian challenge for Wall Street firms,” says Tony Bishop, senior vice president and head of architecture and engineering. The first step in the project, according to Bishop, was to prepare a matrix that cross-referenced every major function (such as research, risk management, selling, trading, clearing, settlement, payment, and reporting) to each major product (debt and equity products, asset-backed finance, derivatives, and so on). The project team then had to take a hard look at the existing systems in each cell. “We looked at the current systems and said, ‘Where can we build standardized frameworks, components and services that would allow us to, instead of building it four different times in silos, build it once and extend it into one common sales platform, one common trading platform and so on?’”

The resulting Service Oriented Enterprise Platform is connected to a 10,000-processor grid using GridServer and FabricServer from DataSynapse Inc.

In its data centers, Wachovia brought in Verari Systems Inc.’s BladeRacks with quad-core Intel processors. Bishop says he’s creating a “data center in a box” because Verari also makes storage blades that can be tightly coupled with processing blades in the same rack. The processing load at the bank involves a great deal of reading and writing to temporary files, and the intimate linkage of computing and storage nodes makes that extremely efficient.

“We now do pricing in milliseconds, not seconds, for either revenue protection or revenue gain,” says Bishop. The advanced infrastructure has tripled processing capacity at one-third the cost, for a ninefold financial return, Bishop adds. Report generation that used to take 16 hours is now done in 15 minutes. “This is where IT becomes the enabler to new business capabilities,” he says.

Executing complex strategies based on arcane mathematical formulas, algorithmic trading systems generate thousands of buy and sell orders every second, many of which are canceled and overridden by subsequent orders, sometimes only a few seconds apart. The goal of these computer traders is to profit from minute, fleeting price anomalies and to mask their intentions via “time slicing,” or carving huge orders into smaller batches so as not to move the market. A one-millisecond advantage in trading applications can be worth $100 million a year to a major brokerage firm, by one estimate.

The fastest systems, running from traders’ desks to exchange data centers, can execute transactions in a few milliseconds—so fast, in fact, that the physical distance between two computers processing a transaction can slow down how fast it happens. This problem is called data latency—delays measured in split seconds. To overcome it, many high-frequency algorithmic traders are moving their systems as close to the Wall Street exchanges as possible.

Wall Street’s quest for speed is not only putting floor traders out of work but also opening up space for new alternative exchanges and e-communications networks that compete with the established stock markets. E-trading has reduced overall volatility in the equities markets, because volatility is a product of herd buying or selling, and e-trading—responding instantaneously to tiny price fluctuations—tends to smooth out such mass behavior. It has also provided established exchanges with new revenue opportunities, such as co-location services for companies that wish to place their servers in direct physical proximity to the exchanges’ systems. E-trading has also created opportunities for a new class of vendors—execution services firms and systems integrators promising the fastest possible transaction times.

At its most abstract level, the data-latency race represents the spear point of the global movement to eradicate barriers—geographic, technical, psychological—to fair and transparent markets. “Any fair market is going to select the best price from the buyer or seller who gets their [sic] order in there first,” says Alistair Brown, founder of Lime Brokerage, one of the new-school broker-dealers, which uses customized Linux servers to trade some 200 million shares a day. “At that point, speed definitely becomes an issue. If everyone has access to the same information, when the market moves, you want to be first. The people who are too slow are going to get left behind.”

**Value in Milliseconds**

On the New Jersey side of the Lincoln Tunnel, in an anonymous three-story building, is one of the financial world’s most important data centers. Pushing the doorbell at the unmarked main entrance won’t get you inside. It’s merely a façade; the real entrance is harder to find.

The servers for five electronic exchanges are located in this data center, along with computers belonging to dozens of trading firms. Run by hosting company Savvis, the Weehawken facility is home to some of the most advanced trading technology anywhere. Much of Savvis’s growth can be traced to the spread of what’s known as direct market access. In the past, traders used consolidated feeds, which are market data updates such as those provided by Reuters.
and Thomson. Distributing those feeds, however, could take up to 500 milliseconds, far too long for today’s automated trading.

“Now you’re seeing a lot of the market data providers and vendors who have direct exchange-feed connectivity,” says Varghese Thomas, Savvis’s vice president of financial markets. Savvis provides connectivity from the exchange directly to the client without having to go through a consolidated system. The exchanges themselves are also profiting from the demand for server space in physical proximity to the markets. Even on the fastest networks, it takes 7 milliseconds for data to travel between the New York markets and Chicago-based servers and 35 milliseconds between the West and East coasts.

Many broker-dealers and execution-services firms are paying premiums to place their servers inside the data centers of the National Association of Securities Dealers (NASDAQ) and the New York Stock Exchange (NYSE).

About 100 firms now co-locate their servers with NASDAQ’s, says Brian Hyndman, NASDAQ’s senior vice president of transaction services, at a going rate of about $3,500 per rack per month. NASDAQ has seen 25 percent annual increases in co-location in the last two years.

Physical co-location eliminates the unavoidable time lags inherent in even the fastest wide area networks. Servers in shared data centers typically are connected via Gigabit Ethernet, with the ultra-highspeed switching fabric called InfiniBand increasingly used for the same purpose, says Yaron Haviv, CTO at Voltaire, a supplier of systems that can achieve latencies of less than a microsecond, or one-millionth of a second. Later this year, NASDAQ will shut down its data center in Trumbull, Connecticut, and move all operations to one opened last year in New Jersey, with a backup in the mid-Atlantic region, Hyndman says. (Trading firms and exchanges are reluctant to disclose the exact locations of their data centers.)

**CASE STUDY QUESTIONS**

1. What competitive advantages can the companies described in the case derive from the use of faster technology and co-location of servers with the exchanges? Which would you say are sustainable, and which ones temporary or easily imitable? Justify your answer.

2. Tony Bishop of Wachovia stated that “competitive advantage comes from your math, your workflow and your processes through your systems.” Referring to what you have learned in this chapter, develop opposing viewpoints as to the role of IT, if any, in the development of competitive advantage. Use examples from the case to support your positions.

3. What companies in industries other than securities trading could benefit from technologies that focus on reducing transaction processing times? Provide several examples.

**REAL WORLD ACTIVITIES**

1. Most of the discussion in the case was done from the perspective of the trading firms and the value that these technologies add to them and their customers. However, the case also mentions actions taken by stock exchanges to improve their transaction processing and turn these needs into a revenue-generating asset. Research what recent technologies have been implemented by major stock exchanges such as NYSE and NASDAQ and prepare a report detailing what benefits have occurred as a result.

2. The technologies described in the case represent an example of how different barriers to the flow of goods and information are being overcome by the use of IT. Break into small groups and select an industry other than the one described in the case; brainstorm what barriers to commerce you see there and how IT may help to do away with them.

The NYSE will begin to reduce its 10 data centers to two in the next couple of years, says CTO Steve Rubinow. Co-location, Rubinow says, not only guarantees fast transactions, but also predictable ones. “If you’ve got some trades going through at 10 milliseconds and some at 1 millisecond, that’s a problem” he says. “Our customers don’t like variance.”

One of the biggest co-location customers is Credit Suisse, which handles about 10 percent of all U.S. equity trades daily and which helped pioneer black-box trading systems with exotic algorithms that go by monikers like Sniper, Guerrilla, and Inline. Credit Suisse maintains Sun and Egenera blade servers, some running Linux and some Windows, in all the major U.S. markets, says Guy Cirillo, manager of global sales channels for Credit Suisse’s Advanced Execution Services (AES) unit, which serves major hedge funds and other buy-side clients.

The AES trading engine in Credit Suisse’s Manhattan headquarters is replicated in London, Hong Kong, and Tokyo.

Guaranteed transaction times for AES clients—from the time the order is received on the Credit Suisse system until it gets an acknowledgment from the exchange, e-communications network or “crossing network”—has dropped from 15 milliseconds to 8 in the last year, Cirillo says. Total execution time also includes any delays within the exchange or “liquidity point” itself, a latency variable over which Credit Suisse has no control.

“That response time is something the ECNs [electronic communications networks] and the exchanges compete on as well,” Cirillo says. “Their latency, their turnaround time, and their infrastructure are all part of the electronic game.”